BANK OF CANADA

INTERNATIONAL ASSET SUBSTITUTABILITY
Theory and Evidence for Canada

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February 1985

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The authors were asked to undertake this study by the Economic Research Program of the Royal Commission on the Economic Union and Development Prospects for Canada. The views expressed in this study are those of the authors; responsibility for them should not be attributed to the Bank of Canada.

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ABSTRACT

The purpose of this study is twofold. First, the authors set out to establish the areas in which the efficacy of monetary, fiscal and foreign exchange market intervention policy under flexible exchange rates is affected by the degree of international substitutability among financial and real assets. Second, they attempt to determine from the available empirical evidence the degree of substitutability for Canadian assets and the resulting policy implications.

The study is not restricted to one theoretical model. The empirical evidence surveyed (supplemented at times with the authors' own estimates) is taken from estimates of various models.

The findings discussed here are fully consistent with the popular perception that the financial markets of Canada and the United States are closely integrated. The empirical results suggest that the mobility of capital across the Canada-U.S. border is high and that Canadian dollar and U.S. dollar assets are perceived to be close substitutes for one another. Indeed, except over the very short run, it is difficult to reject empirically the hypothesis that short-term Canadian and U.S. financial assets are perfect substitutes.

This high degree of substitutability of financial assets has important implications for the conduct of policy. In particular, the short-run effects of monetary policy on output and prices under flexible exchange rates are heightened, while the effects of fiscal and intervention policy are moderated. For the longer run, the implication is that real interest rates in Canada cannot vary substantially from those in the United States. Fiscal policy can play a useful role in stabilizing economic activity -- even in the presence of perfect capital substitutability. Models that deny a short-run role for fiscal policy make extreme assumptions about the way expectations are formed and about wage and price flexibility.

For real capital assets (the stock of business fixed assets as opposed to financial assets) there is no strong evidence in favour of or

against the perfect capital mobility hypothesis. The evidence is consistent with very low mobility in the short run and quite high, if not perfect, mobility in the long run. With less than perfect mobility, budget deficits would cause some crowding out of domestic investment as well as some reduction in the balance on current account.

PREFACE

An earlier version of this study was discussed by the Research Advisory Group on Macroeconomics of the Royal Commission on the Economic Union and Development Prospects for Canada in January 1984. We thank that group — in particular Pierre Fortin, David Laidler, John Sargent and Brian Scarfe — for their perceptive questions and suggestions.

The study went through the normal refereeing process for research undertaken for the Economic Research Program of the Royal Commission, and we thank the two anonymous referees for their helpful comments and references.

Our colleagues at the Bank also made many suggestions that have been incorporated in this study. The research assistance of Doug Hostland is gratefully acknowledged, as is the excellent editorial assistance of Lea-Anne Solomonian. We also thank the secretaries in the International and Secretary's Departments who contributed to the typing of the many drafts of the study.

While each of us had significant input into the various aspects covered in this paper, David Longworth was the primary author of Chapter 2 and the part of Chapter 3 dealing with monetary policy, Kevin Clinton was the primary author of the remainder of Chapter 3 as well as Chapter 5, and Paul Boothe and Agathe Côté were the primary authors of Chapter 4.

CHAPTER 1

INTRODUCTION AND SUMMARY OF CONCLUSIONS

1.1 Introduction

There is a popular perception that the financial markets of Canada and the United States are closely integrated and the findings presented in this study are fully consistent with that premise. Our empirical results suggest that the mobility of capital across the Canada-U.S. border is high and that Canadian dollar and U.S. dollar assets are perceived to be close substitutes for one another. Indeed, except for the very short run, it is difficult to reject empirically the hypothesis that short-term Canadian and U.S. financial assets are perfect substitutes.

According to definition, high mobility means that comparable domestic and foreign instruments covered in the foreign exchange market are close to perfect substitutes and there is no premium for differential political risk (i.e., risk of capital controls or default). High substitutability, in contrast, means that the market pays no premium for exchange rate risk on domestic and comparable uncovered foreign instruments. Any forward premium or discount would be equal to the expected increase or decrease in the price of foreign exchange.

A high degree of substitutability of financial assets has important implications for the conduct of monetary, fiscal and foreign exchange market intervention policy in a flexible exchange rate regime. In particular, the short-run effects of monetary policy on output and prices under flexible exchange rates are heightened, while the effects of fiscal and intervention policy are moderated. For the longer run, the evidence indicates that real interest rates in Canada cannot vary very much from those in the United States. Even in the presence of perfect capital substitutability, fiscal policy can play a useful role in stabilizing economic activity . Models that deny this short-run role for fiscal policy make extreme assumptions about the way expectations are formed and about wage and price flexibility.

For real capital assets (the stock of business fixed assets as

opposed to financial assets) there is no strong evidence in favour of or against the perfect capital mobility hypothesis. The evidence is consistent with very low mobility in the short run and quite high, if not perfect, mobility in the long run. With less than perfect mobility, government budget deficits would cause some crowding out of domestic investment as well as some reduction in the balance on current account.

1.2 Scope and Purpose of the Study

The purpose of this study is actually twofold. First, we wish to establish the areas in which the efficacy of policy under flexible exchange rates is affected by the degree of international substitutability among financial and real assets. Second, we attempt to determine from the empirical literature the degree of substitutability for Canada and the resulting policy implications. We note at the outset that in many cases policy prescriptions will depend less on the degree of substitutability than on other assumptions made about the economy, such as the formation of expectations, the degree of wage and price stickiness, and the degree of uncertainty about the economic structure.

In our study, we consider the implications of foreign exchange market intervention, monetary policy, and fiscal policy for output and prices. With respect to foreign exchange market intervention, the main question is whether asset substitutability is so high as to negate the use of intervention as an independent policy instrument. We then examine the question of the degree of asset substitutability and the effectiveness of monetary policy in two parts. In the first, we are concerned with the effects through the channels of real exchange rates and short-term real interest rates. In the second part we are concerned with the long-term real interest rate. Next, in the context of high asset substitutability, we ask whether fiscal policy can affect domestic output in the short-to-medium run. An important question here is the degree to which changes in fiscal policy have crowding out effects on private fixed investment as opposed to effects on the balance of payments.

In our examination, we do not restrict ourselves to one theoretical

model. The empirical evidence that we survey (supplemented at times with our own estimates) is taken from estimates of various models, not all of which are consistent with one another. The most general model would allow for imperfect substitutability across countries, currencies, and classes of assets. Our study proceeds under the assumption that there may be some degree of imperfect substitutability in Canada among five asset classes: currency, short-term money-market instruments, long-term bonds, equity capital, and real capital. The degree of substitutability for each class of asset is considered separately.[1] Since financial linkages with the United States are tighter than with other foreign countries, most of the empirical work we examine deals with the substitutability between claims on Canadians and on Americans and/or with the substitutability between Canadian-dollar-denominated assets and U.S.-dollar-denominated assets.

Perfect asset substitutability for one class of financial asset will dominate demands for other classes in the determination of exchange rates. Therefore, because short-term assets are likely to have the highest degree of substitutability, we will begin with this category.[2] Our examination of exchange market intervention in Chapter 2 focuses on results for short-term assets, supplemented at times with results for all maturities of bonds. In Chapter 3 the same evidence is used in our examination of monetary policy and short-run fiscal policy. Evidence on the international substitutability of long-term bonds is introduced in Chapter 4, which examines whether monetary policy can work through its effects on long-term bond rates.

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1. We do this in order to survey the existing empirical literature. The conditions under which portfolio allocation decisions for each class of asset would actually be undertaken separately would likely be rather stringent.

2. If all classes of assets are to some extent internationally substitutable, but less than perfectly so, then presumably these varying degrees of substitutability must be taken into account in determining policy implications in the three areas we consider. However, it is reasonable to assume, if there are differences in the degree of substitutability across classes of assets, that the ranking from the most substitutable to the least substitutable will be as follows: short-term financial instruments, long-term bonds, equity capital, and fixed investment. This ranking is based on the degree of comparability of assets across countries as well as the 'term to maturity'. (Currency substitution is left out of this ranking since the desire to hold domestic currency depends a great deal on the costs of transacting domestically in foreign currencies or other assets.)

In Chapter 5, the mobility of real capital assets is discussed, as well as the long-run elasticity of the overall flow of real savings (which is equal to the balance of payments on current account). The evidence is used to make some inferences about the longer-run allocative effects of fiscal policy.

1.3 Summary of Findings and Conclusions

The available empirical evidence suggests that perfect capital mobility is a good approximation to the Canadian case, as covered interest differentials on short-term assets denominated in Canadian and U.S. dollars are very small (Appendix A). Therefore, emphasis is placed on models that can be used to answer questions about the degree of asset substitutability — models of the portfolio-balance type.

In most of the empirical work reported or surveyed, perfect substitutability of short-term assets cannot be rejected, except in the short run. The work surveyed falls into five categories: rational expectations models where all investors have the same portfolio preferences, irrespective of country of residence; rational expectations models where investors have a preference for local currency bonds; general two-country, portfolio-balance models; models with short-run imperfect substitutability but long-run perfect substitutability; and the theoretically eclectic equations found in Canadian macroeconometric models.[3]

Rational expectations models generally do not provide statistically significant evidence that differences in expected rates of return on Canadian and U.S. dollar short-term instruments are dependent on stocks of Canadian or U.S. government bonds, as they would if such assets were imperfect substitutes. This implies that there is no evidence of a variable risk premium depending on asset stocks. Since recent empirical

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3. The models that we looked at include the Bank of Canada's RDXF and SAM models, the Economic Council's CANDIDE 2.0, the University of Toronto's FOCUS, the University of British Columbia's MACE, the Conference Board's MTFM, and the DRI model.

work has strongly rejected the joint hypothesis of rational expectations and a constant risk premium, our interpretation of the evidence is that there is likely a failure of the rational expectations hypothesis;[4] indeed, it seems that expectations can often be of an adaptive or extrapolative nature.

The general two-country, portfolio-balance models found in the literature can be divided into four types: (1) those in which the exchange rate is the dependent variable and the stock of net foreign assets is an independent variable; (2) those in which the stock of net foreign assets is the dependent variable and the exchange rate is an independent variable; (3) those in which the exchange rate is the dependent variable and the existing stocks of domestic money, foreign money, domestic currency bonds and foreign currency bonds are important explanatory variables; and (4) those in which the stock of government bonds is the dependent variable and rates of return are the important explanatory variables. In specifications of type (1) that include relative price levels (to measure purchasing-power parity), the stock of net foreign assets is found to be an insignificant determinant of the exchange rate. Models of type (2), such as the MACE model, are very sensitive to the time period of estimation. Models of types (3) and (4) have been classed by their authors as generally unsatisfactory in their explanatory power. Overall, there is little support for a portfolio-balance specification from these four types of models.

There is an indication that foreign and Canadian short-term assets are not perfect substitutes in the short run, as the balance of payments variables are found to have a significant impact on the exchange rate (for example, in the RDXF model).

In common with RDXF, there are no portfolio-balance (stock) effects on the exchange rate in the CANDIDE 2.0 or FOCUS models of the Canadian economy. The DRI and MTFM models show such stock effects but both exclude a relative price term which is found to be highly significant in models

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4. In these models the 'rational' expectations hypothesis implicitly embodies the notion that information is costless.

such as RDXF. However, the SAM and MACE annual models do have stock effects.

Overall, perfect capital substitutability cannot be rejected, except in the short run, in most of the empirical work that we describe. In particular, changes in the stocks of Canadian or U.S. government bonds and shifts in financial wealth internationally do not appear to affect expected differences in rates of return on Canadian and U.S. dollar instruments. Empirically, the interest rate in Canada is approximately equal to the interest rate in the United States plus the expected rate of depreciation of the Canadian dollar.

With respect to policy, one implication of our finding of very high substitutability of short-term assets is that official intervention cannot work through a portfolio-balance channel to affect the exchange rate except over a fairly brief period. However, intervention may play a signalling role, and the presence of short-run imperfect substitutability means that it can be used as a smoothing device for the exchange rate over the short run.

The high degree of substitutability of short-term, interest-bearing assets also has important implications for monetary policy. (Currency substitutability, in contrast, is not found to be economically important in the empirical literature.) These implications depend importantly on the economic model used — that is, whether one believes that the economy can be represented by a Mundell-Fleming model (perhaps augmented by additional features), a classical model, or a new-classical rational expectations model.

As a rule, however, the more highly substitutable domestic and foreign assets are, the greater the short-run impact of changes in monetary policy on domestic output and prices and the more they work through the exchange rate than through interest rates. The amount by which the real interest rate (the nominal interest rate adjusted for expected domestic inflation) will decline because of an expansionary monetary policy is determined not only by the degree of asset substitutability but by the degree of wage and price rigidity in the economy and by the way expectations of future exchange rate movements are

formed. The available empirical evidence suggests that, in the short run, real interest rates can differ internationally and can be influenced by changes in domestic monetary policy. Moreover, such changes in interest rates are likely to be associated with changes in the real exchange rate.

In the discussion of monetary policy we do not consider the long run in any detail. This is because in the long run, money can be assumed to be approximately neutral: a higher rate of money growth leads to an equally higher rate of inflation, with only second-order effects on real variables. This quantity theory result is independent of the degree of capital substitutability.

A change in fiscal policy will have a smaller short-run effect on output the higher the degree of asset substitutability. However, with sticky wages and prices and non-static exchange rate expectations, even with perfect substitutability there is room for some short-run output effect.

The degree of substitutability between U.S. and Canadian long-term bonds influences the independence of Canadian long-term interest rates. The comparison of expected domestic and foreign bond yields requires some assumptions concerning expectations about future changes in the exchange rate. In addition, the relationship between short- and long-term bonds depends on expectations about future short-term bond yields. In order to understand the formation of expectations in these two markets, evidence regarding the joint hypothesis of rational expectations and a constant risk premium was examined. For the bond market, the evidence surveyed showed that expected holding-period yields for Canadian short- and long-term bonds showed systematic differences, thus rejecting the joint hypothesis for the term structure. For the foreign exchange market, we present new evidence that confirms previous work rejecting the joint hypothesis. The implication of this finding is that it may not be appropriate to confine tests of asset substitutability to models that impose rational expectations and assume that all information is costless.

Bond rate equations from Canadian econometric models show little evidence of the significant stock variables necessary for imperfect substitutability in a portfolio model framework. These equations are

consistent with the hypothesis that the only significant variables determining Canadian bond rates are U.S. long- and short-term rates, and Canadian short-term rates. Updated estimates, using yields on hypothetical constant maturity bonds, strongly confirm these findings. All this points to perfect substitutability as a useful working hypothesis.

Capital flow equations in Canadian econometric models, however, often have significant interest rate differential variables. This means that at least some agents do not regard Canadian and foreign bonds as perfect substitutes. In these equations, the aggregation over a broad range of assets as well as agents with dissimilar (non-homogeneous) preferences and expectations makes it difficult to interpret these results more confidently.

Political risk on long-term bonds is measured as the yield differential between bonds whose only difference lies in the citizenship of the issuer. Thus, political risk is best measured by comparing bonds of different governments issued in a common currency. Not much work on this question has been done, but one study indicates that a premium of about 0.6 per cent is paid on Government of Canada U.S.-dollar-pay bonds over comparable U.S. government bonds. This indicates an element of immobility for long-term capital that is not found for short-term capital.

Our estimated equations imply that even with perfect longer-term asset substitutability it is possible to affect domestic real long rates in the short run by changing short-term rates. There exists, therefore, a possible channel through which the authorities can affect the components of aggregate demand that are sensitive to long-term interest rates (e.g., housing, investment, consumer durables). With perfect substitutability, however, this influence will eventually disappear, since over the longer run, the expected change in the exchange rate will conform to the expected inflation differential between the two countries.

The substitutability of real capital assets has implications for the longer-run allocative effects of fiscal policy. With respect to the balance of payments, we describe two ways to examine the substitutability of real capital between Canada and abroad. The first is to study components of the capital account corresponding to capital ownership --

i.e., direct and equity investment. The second is to study the behaviour over time of the net flow of real saving, which is by definition equal to the current account balance.

The evidence from direct and equity investment equations is mixed. Factors other than measured rates of return, such as changes in government policies, the industrial strategies of multinational firms, trade controls, etc. have exerted a preponderant influence on these flows. Tests are further hampered by the fact that strictly comparable rates of return across countries cannot be found. In any event, data on balance of payments flows as well as on current account/savings/investment behaviour across a number of industrial countries convey the impression of a world capital market that is quite segmented.

Just as for other assets, substitutability of real capital can also be assessed from the closeness of returns in Canada and abroad. Average measured rates of return on capital and equity in Canada and the United States diverged considerably during certain subperiods, but over the past two decades as a whole, there has been no significant difference. Given the problems of inter-country comparisons, not too much can be made of these findings, except that they are consistent with a low short-run substitutability and a high long-run substitutability. We might conclude that the supply of real capital from abroad to Canada is more elastic than to most other countries, but that it might be far from infinitely elastic. More research would be justified in this area: not many studies have been done, and it would seem important to explore this point further.

With a vertical supply curve for real output, there can be no long-run effect of fiscal policy on the level of output, but the degree of substitutability of real capital has important allocative implications. If capital substitutability is perfect, then an increase in the government deficit can be financed by an inflow of capital from abroad with no significant increase in domestic interest rates. That is, the current account balance would be 'crowded out' dollar for dollar with the increased deficit, with no crowding out of domestic investment. The consequences for gross national product (GNP), as opposed to gross domestic product might, however, be just as severe because net foreign

investment by residents decreases identically with the decline in the current account balance and thus net interest and dividend inflows would decrease over time.

In practice, substitutability is probably high enough that an increased government deficit can be expected in the long run to have a significant downward impact on the current account. The size of the current account impact would depend to some extent on the uses to which the deficit financing is put. An increase in government investment could be expected to attract a greater inflow of financing over time from abroad than an increase in government consumption since, in the long run, productive investment itself provides the means by which the financing may be serviced.[5] An increase in government consumption would probably put greater upward pressure on domestic interest rates in the long run since, in the absence of an increased capital stock, a risk premium would likely be required to induce non-residents to hold increased national debt. Hence, increased government consumption spending would likely have a stronger crowding out effect on private investment than would increased government investment spending.

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5. This would imply that in cost-benefit analyses the social rate of discount should be calculated with a quite high weight on the foreign interest rate.

CHAPTER 2

OFFICIAL FOREIGN EXCHANGE MARKET INTERVENTION

2.1 Introduction

In this chapter we consider whether sterilized official foreign exchange market intervention can affect the Canadian exchange rate. By sterilized intervention we mean purchases and sales of foreign exchange by the Bank of Canada that are not allowed to affect the reserves of the chartered banks.[1] Such intervention has recently been the subject of survey papers by Genberg (1981) and Solomon (1983) and of the Report of the Working Group on Exchange Market Intervention (1983).

Sterilized intervention can affect the exchange rate under any or all of the following conditions[2]:

(i) if there is imperfect substitutability between domestic and foreign bonds and government bonds are treated as net wealth;

(ii) if intervention is an indicator of future changes in monetary policy and therefore affects market expectations;[3]

(iii) if intervention affects short-run exchange market sentiment, expectations and/or dynamics, perhaps by conveying to the public neglected or otherwise unavailable information (Loopesko (1983)).

Given the focus of our study, we will for the most part be examining the empirical evidence on condition (i). However, since all empirical work must concern itself with the formation of expectations, we do touch on the other two conditions as well.

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1. The reserves provided to the chartered banks by the Bank of Canada from day to day are independent of the amount of intervention. In this sense intervention is 'automatically' sterilized.

2. See, for example, Loopesko (1983).

3. A point stressed by Mussa (1981).

After a short discussion of exchange rate expectations in Section 2.2, we proceed to a section on theoretical models in which sterilized intervention has an effect (2.3). 'Portfolio-balance' models are emphasized here. The following section, (2.4), discusses empirical estimates of international capital substitutability. A concluding section looks briefly at the stability of asset demands and exchange rate volatility and examines the implications of the evidence for intervention policy.

2.2 Expectations in Exchange Rate Models

The specification of the way expectations are formed is an important part of any capital flow or exchange rate model because it will have a strong bearing both on the coefficients estimated and on the way the equation will be used to determine how policy changes will affect the exchange rate. In this section, which provides necessary background to the empirical models considered in later sections, we deal with expectations of future exchange rates and discuss whether they are rational, adaptive, or extrapolative.

2.2.1 Rational expectations

The concept of rational expectations -- or efficient markets, as the concept is often termed with respect to financial markets -- has dominated the literature in the last decade. However, recent findings, summarized and extended in Longworth, Boothe and Clinton (1983), reject the joint hypothesis of rational expectations and a constant risk premium in exchange markets.[4] Furthermore, the evidence appears to indicate that a failure of rational expectations is at least part of the reason the joint

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4. Other recent studies rejecting the joint hypothesis for the Canadian dollar include: Bilson (1981), Boothe (1983), and Longworth (1981a) and (1983).

hypothesis is rejected.[5, 6]

2.2.2 Adaptive expectations

Although exchange rates can move rapidly -- and often do -- upon the release of certain new information, there is empirical evidence in the case of the Canadian dollar that suggests adjustment to fundamental factors such as relative prices, the basic balance, and interest rate differentials tends to be relatively slow.[7] The estimated short-run effects of these variables on the exchange rate are smaller than the long-run effects. This is consistent with expectations being formed adaptively, as Longworth et al. (1983, p.6) explain:

> Costs to private traders of processing information and the limited supply of private funds available for long-term currency speculation could be responsible. While private traders put intensive efforts into obtaining and analyzing information that aids in predicting very short-run exchange rate movements, it remains the case that sophisticated models incorporating basic causal variables do not provide significantly better short-run forecasts than some fairly naive formulas, e.g., forecasts based on the recent history of the exchange rate itself.

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5. Under the joint hypothesis, the change in the exchange rate should be positively related to the beginning-of-period forward premium with a coefficient of 1. However, in the empirical work for the Canadian dollar, and for many other currencies, the coefficient is negative irrespective of whether proxies for risk are included in the equation. (See Longworth et al. (1983).) For example,

$$\Delta s_{t+1} = \underset{(.0009)}{.0005} \; \underset{(.550)}{-.389} \; fp_t \quad (1970M7\text{-}1981M12)$$

where Δs is the change in the logarithm of the spot rate and fp is the difference between the logarithms of the 1-month forward rate and the spot rate (standard errors in brackets). It is sometimes argued that intervention can render a market inefficient according to these econometric tests. However, this is not true, for, if the exchange market is efficient, then spot and forward exchange rates must reflect, among other things, known past intervention and rationally forecasted future intervention (Longworth et al. (1983, Appendix E)).

6. Here we are using the term 'rational' in its technical sense in models where there are no costs to information-gathering and economic agents are homogeneous.

7. See, for example, Section 4.4.

Such adaptive behaviour is not necessarily irrational when costs are taken into account. Indeed, in certain cases, adaptive expectations are rational even in the absence of costs of information.[8] In any event, adaptive expectations seem to be a reasonable way of summarizing the past behaviour of the Canadian dollar.

2.2.3 Market behaviour, announcement effects, and extrapolative expectations

Since exchange market participants are constantly processing new information, unexpected changes in economic variables may have sizeable impacts on the exchange rate. In an efficient market, the immediate changes in the exchange rate would reflect unbiased forecasts of the ultimate effect of the changes in the rate. In the real world, however, such changes sometimes trigger 'bandwagon' effects in the exchange market whereby exchange rate expectations become extrapolative.

It is difficult to know how the exchange market will judge announcements of changes in government policies. For example, it is possible that the small estimated effects of typical intervention operations could be overwhelmed by adverse expectational effects if the market became aware of a significant shift in intervention policy. In the case of intervention policy, the expectational effects could be predominant, especially if a change in strategy is perceived to indicate a change in monetary policy.

2.2.4 Conclusions on exchange rate expectations

There is good reason to believe that movements in the Canadian/U.S. dollar exchange rate are not always fully rational. Rather, they can often be of an adaptive or extrapolative nature. In these circumstances

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8. Muth (1960) shows that the simplest adaptive expectations scheme is rational when a variable can be represented as $x_t = \varepsilon_t + \beta \sum_{i=1}^{\infty} \varepsilon_{t-i}$.

there may be sufficient grounds for some corrective policy action. Whether intervention will be able to exploit the non-rationality of expectations in the desired way will depend on the presence of one of the conditions mentioned in Section 2.1 plus the absence of undesirable speculative effects resulting from the market's reading of a shift in intervention policy.

2.3 Theoretical Models of Exchange Rate Determination

Modern 'asset-market' models of exchange rate determination can be broadly divided into monetary-approach models and portfolio-approach models.[9] The difference between the two approaches is that perfect capital substitutability between domestic and foreign currency bonds is assumed in the monetary approach, but not in the portfolio approach. Perfect capital substitutability is a different condition from perfect capital mobility, which we define as the absence of capital controls (existing or expected), default risk, and significant transactions costs.[10, 11] In the absence of perfect capital mobility, political risk (Aliber (1973)) is said to exist, whereas in the absence of perfect capital substitutability, exchange risk is said to exist.

Political risk manifests itself in significant deviations from covered interest parity -- the situation where the return on a domestic asset is equated to the return on a comparable foreign asset covered in the foreign exchange market.[12] The absence of exchange risk, however, shows itself in the presence of uncovered interest parity -- the equality

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9. See Frankel (1980) for a taxonomy of exchange rate models.

10. In the literature of the 1960s perfect capital mobility included the concept of perfect capital substitutability. It is analytically convenient to distinguish between the two concepts.

11. Stock-adjustment models are assumed to reflect significant transactions costs or aggregation over individual agents who adjust fully at different points in time.

12. $(1+i)=(1+i^*)\frac{F}{S}$ where i and i* are the domestic and foreign interest rates, F is the forward price of foreign exchange, and S is the spot price of foreign exchange. The logarithmic approximation is $i-i^*=f-s$, where $f=\ln F$ and $s=\ln S$.

Table 1

MOBILITY AND SUBSTITUTABILITY

Perfect Capital Mobility	Perfect Capital Substitutability
- domestic bonds and covered foreign bonds are perfect substitutes	- domestic bonds and uncovered foreign bonds are perfect substitutes
- no political risk premium (absence of capital controls (existing or expected), default risks, and significant transactions costs)	- no exchange risk premium
- covered interest parity holds	- uncovered interest parity holds

between the interest rate differential and the expected change in the exchange rate.[13] Table 1 outlines the differences between perfect capital mobility and perfect asset substitutability.

When both uncovered interest parity and covered interest parity hold — that is, when there is perfect mobility and substitutability of capital -- a major channel through which sterilized intervention can act is eliminated. If either parity condition fails to hold, intervention will be available as an independent policy instrument (Eaton and Turnovsky (1983b)).[14] Since covered interest parity holds to a close approximation for Canada (Appendix A), we restrict ourselves to an examination of theoretical models where it does hold and where the emphasis can be placed on whether or not uncovered interest parity holds, that is, the broad class of portfolio-balance models.

There is no agreed-upon taxonomy of portfolio-balance models in the literature.[15] The models differ in their assumptions about asset

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13. In the notation of footnote 12, $i-i^{*}=\Delta s^{e}$, where e denotes the average market expectation, not the mathematical expectations operator.

14. If only covered interest parity fails to hold, then intervention in the forward exchange market will have a different effect from a change in the mix of domestic and foreign bonds (spot market intervention) (Eaton and Turnovsky (1983b)).

15. Frankel (1980), however, does divide (some of) them into three classes: the uniform-preference model, the preferred-local-habitat model, and the small-country model.

preferences across countries, about whether the monetary base should be aggregated with bonds held by the private sector, and about whether one country is 'small' relative to the rest of the world. Moreover, the empirical specification differs considerably, even for similar models. In this section we discuss only two-country portfolio-balance models. Discussion of simpler models, which assume uniform preferences across countries or 'symmetric' preferences for the domestic currency, is reserved until Section 2.4. In all of these models, sterilized intervention changes relative asset stocks and thereby causes asset prices -- including the exchange rate -- to change to bring about a new portfolio-balance equilibrium.

A fairly general two-country portfolio-balance model (see, for example, Tryon (1983)) can be constructed such that Canadian residents hold Canadian money (as represented by the monetary base M) and Canadian (B_C) and foreign bonds (B_C^*), and foreign residents hold foreign money (M^*) and Canadian (B_F) and foreign bonds (B_F^*):

$$
\begin{aligned}
M &= M(i, i^*, \Delta s^e, Y/W_C)W_C & \qquad M &= \bar{M} \\
B_C &= b_C(i, i^*, \Delta s^e, Y/W_C)W_C & \qquad M^* &= \bar{M}^* \\
SB_C^* &= b_C^*(i, i^*, \Delta s^e, Y/W_C)W_C & \qquad B_C + B_F &= \bar{B} \\
M^* &= M^*(i, i^*, \Delta s^e, Y^*/W_F)W_F & \qquad B_C^* + B_F^* &= \bar{B}^* \\
B_F/S &= b_F(i, i^*, \Delta s^e, Y^*/W_F)W_F & \qquad W_C &= M + B_C + SB_C^* \\
B_F^* &= b_F^*(i, i^*, \Delta s^e, Y^*/W_F)W_F & \qquad W_F &= M^* + B_F/S + B_F^* \qquad (1)
\end{aligned}
$$

In each case, the asset demands depend on domestic and foreign interest rates (i and i^*) and expected exchange rate changes (Δs^e, where s is the logarithm of the price of foreign exchange, S), as well as on domestic income (Y) or foreign income (Y^*). Since for each country the sum of the asset demands equals wealth (W_C,W_F), one of the equations is linearly dependent on the other two. The system of equations can be solved for i, i^*, s (given s^e), the wealth terms and the asset stocks.

If money demand does not depend on wealth [16] and the split between the demand for domestic and foreign bonds does not depend on income, the key equations determining s (given interest rates determined in the money market and given s^e) can be written as:

$$B_c = b_c(i, i^*, \Delta s^e)W_c';\ W_c' = B_c + SB_c^*;\ B_c + B_F = \overline{B}$$

$$B_F/S = b_F(i, i^*, \Delta s^e)W_F';\ W_F' = B_F/S + B_F^*;\ B_C^* + B_F^* = \overline{B}^* \qquad (2)$$

In the above set of equations, it is likely that the demand equations for portfolio shares will depend only on differences in the rates of return so that a convenient simplification is symmetry of response to i,i* and Δs^e so that one can write

$$B_c = b_c(i - i^* - \Delta s^e)W_c'$$

$$B_F/S = b_F(i - i^* - \Delta s^e)W_F' \qquad (3)$$

Another way to simplify the model would be to assume that the monetary base and domestic bonds are perfect substitutes. This leads to a system that can also be represented as system (3), but where B and B* are now defined as the sum of outside [17] bonds and the monetary base in domestic and foreign currency, respectively.

2.4 Empirical Models

2.4.1 Overview

Political risk on Canadian short-term assets does not appear to be important; deviations from covered interest arbitrage are small (as are

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16. Most empirical models of demand for narrowly defined money in Canada and the United States do not include wealth as an argument. However, to counter this, it could be argued that the distributed lag on income that is found in many equations represents permanent income, which is the return on wealth.

17. 'Outside' bonds are government bonds considered by investors to be net wealth.

transactions costs in the foreign exchange market) and domestic interest rates are, if anything, lower than Euro-Canadian rates, rather than bearing a positive risk premium. Quantitative evidence on these features of Canadian financial markets is presented in Appendix A.

Given the seeming unimportance of relative political risk, the empirical models presented below can generally be regarded as examining the presence of exchange risk. [18]

The varying ways in which portfolio-balance models have been estimated reflect:

(i) different simplifying assumptions made by authors (e.g., as to the symmetry of demand functions, small country, etc.);
(ii) different assumptions about expectations (Section 2.2);
(iii) whether portfolio-balance effects are merely being tested for, or whether a full structural model is being estimated; and
(iv) different choices of the dependent variable.

Models such as the one described in Section 2.3 may be estimated in three ways [19]:

(i) in structural form, with a stock variable as the dependent variable;
(ii) inverted to solve for a rate variable -- the exchange rate, the interest rate differential, or a measure of the 'risk premium' ($i-i^*-\Delta s^e$); or
(iii) in terms of a derived capital flow equation.

Empirical results often depend heavily on which variable is chosen as the dependent variable. Therefore, conclusions drawn about substituta-

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18. However. to the extent that domestic interest rates rather than Euro-Canadian rates are used, the models cannot be regarded as pure exchange risk models. Furthermore, in articles published before, say, 1980, it is not clear that authors distinguished in their own minds the differences between the two types of risk.

19. Tryon (1983, pp 3-4) presents a detailed discussion of why one method of implementation may be chosen over another.

bility and about the effectiveness of intervention depend heavily on whether an author chooses a stock or a rate variable as the dependent variable.[20]

Use of rate variables as dependent variables seems strongly advisable for the following reasons:

(i) Because of low transactions costs, rapid information flows and the fact that Canadian financial markets are highly integrated with those abroad, there is a presumption that capital flow elasticities are fairly high. As the degree of substitutability between domestic and foreign capital goes to infinity one cannot trust the estimates of elasticities in equations where the dependent variable is a stock -- indeed the estimated elasticity may not be significantly different from zero (see Appendix B).

(ii) Asset prices adjust rapidly to exogenous changes in supplies of assets and other exogenous shocks.

(iii) In the context of complete models, if policy makers are concerned with the effect of policy on the exchange rate, they are interested in the best estimate of the derivative of the exchange rate with respect to the stock variable(s) influenced by exchange market intervention.[21]

(iv) In the context of tests for rational expectations, the econometrics are greatly simplified.[22]

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20. Additional econometric problems may arise. When there is a degree of imperfect substitutability, some degree of simultaneous equations bias is likely, which calls for the use of simultaneous estimation techniques. If there are serially correlated residuals in the demand function, then a moving average component will arise in rational expectations models where the realized exchange rate is substituted as a proxy for the expected exchange rate. Danker et al. (1984) discuss this case and the appropriate two-step two-stage procedures (see, for example Cumby et al. (1983)).

21. See footnote 8 in Tryon (1983).

22. Under rational expectations the risk premium is

$$i-i^*-\Delta s^e = i-i^*-s_{+1}+ s + \varepsilon$$

where ε is white noise. The variable $i-i^*-s_{+1}+s$ can then be used as the dependent variable, with ε forming part of the composite error of the estimating equation.

The empirical evidence to be examined on the substitutability of short-term assets is discussed in subsections 2.4.2 through 2.4.6. This evidence includes tests of the uniform-preference model under rational expectations, tests of the symmetric-local-habitat model under rational expectations, the general two-country model, and a model with imperfect substitutability in the very short run only. As well, we include a survey of evidence from Canadian macroeconometric models, which take an eclectic empirical approach to the question.

2.4.2 The uniform-preference model under rational expectations

If all investors have the same portfolio preferences, irrespective of country of residence, then their asset demand functions may be aggregated to get the total asset demand function:

$$\frac{B}{SB^*} = a + b\,(i - i^* - \Delta s^e) \qquad (4)$$

where B is outside bonds (government bonds considered as net wealth) in Canadian currency, and
B^* is outside bonds in foreign currency.

Such a demand function can be derived by assuming the maximization of expected utility by risk-averse investors who each consume the same good or basket of goods (Frankel (1979a)). The implication of the equation is that a central bank purchase of Canadian currency bonds with foreign currency bonds will lower the price of foreign exchange with respect to its expected future value.

When this model is combined with the assumption of rational expectations ($\Delta s^e = s_{+1} - s + \varepsilon$) one arrives at the following equation:

$$i - i^* - s_{+1} + s = \frac{-a}{b} + \frac{1}{b}\frac{B}{SB^*} + \varepsilon \qquad (5)$$

Furthermore, if covered interest parity holds:

$$s_{+1} - f = a' + b' \frac{B}{SB^*} - \varepsilon \quad \text{where}$$

$$a' = a/b \quad b' = -1/b < 0 \tag{6}$$

When this equation is estimated over the 1971M1-1982M11 period, the results reported in Table 2 are obtained. The equations reported there differ in the definitions used for the outside asset variables B and B*. However, the results are uniform in that the asset ratio (B/SB*) has a coefficient of the wrong sign. Thus, there is no support for a uniform-preference portfolio-balance model. This is consistent with Rogoff's (1984) finding with weekly data on outside assets for Canada and the United States that portfolio-balance variables appear with the incorrect sign.[23]

2.4.3 Symmetric local habitat and rational expectations

Since investors usually have a preference for goods produced locally over goods produced abroad, in order to protect expected purchasing power there will likely be a preference for local currency bonds rather than bonds denominated in another currency. Thus shifts in wealth, through current account surpluses for example, could change the demand for bonds in a particular currency.

There are a number of ways to reduce the complexity of the problem by introducing types of symmetry between the preferences of Canadian and foreign residents. One approach is to assume that portfolio shares of the two groups of residents respond in the same manner to differences in the rates of return (as in Frankel (1982c)):

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23. Frankel (1982c) failed to find significant asset-stock variables in his study of the German mark/U.S. dollar exchange rate.

Table 2

1971M1 - 1982M11

$s_{+1} - f = a' + b' (B/SB^*)$

B	B*	a'	b'	S.E.E.	D.W.
Federal marketable debt (privately held) plus monetary base plus coin	World supply of U.S. dollar debt issued by the United States plus Canadian federal Government U.S. dollar debt	-0.0098 (1.05)	1.36 (1.14)	0.0131	2.11
Federal marketable debt (privately held) plus monetary base	As above	-0.0093 (1.02)	0.133 (1.11)	0.0131	2.11
Federal marketable debt (privately held) plus monetary base plus Canada Savings Bonds	As above	-0.0199 (1.52)	0.185 (1.59)	0.0130	2.12
Federal plus provincial	As above plus provincial and municipal U.S. debt	-0.0153 (1.20)	0.079 (1.27)	0.0131	2.11

t-statistics in parentheses

$$\frac{B_c}{W_c} = a_o + b(i-i^*-\Delta s^e) \tag{7}$$

$$\frac{B_F}{SW_F} = a_1 + b\,(i-i^*-\Delta s^e) \tag{8}$$

$$\frac{B}{W} = \frac{B_c + B_F}{W} = \frac{a_o W_c}{W} + \frac{a_1 SW_F}{W} + b(i-i^*-\Delta s^e) \tag{9}$$

$$\frac{B}{W} = a_1 + (a_o - a_1)\frac{W_c}{W} + b(i-i^*-\Delta s^e) \tag{10}$$

where W = world wealth $B+SB^*=Wc+SW_F$, measured in Canadian dollars,
W_c = Canadian wealth,
W_F = foreign wealth, measured in foreign currency,
B_c = Canadian dollar bonds held by Canadians,
B_F = Canadian dollar bonds held by foreigners, and
B^* = foreign currency outside assets (measured in foreign currency).

The above model can be expanded to a three-country model incorporating Canada, the United States, and the rest of the world. In that case, the demand for Canadian bonds can be written as:

$$\frac{B}{W} = a_o\frac{W_c}{W} + a_1\frac{SW_{us}}{W} + \frac{a_2 W_r}{W} + b(i-i^*-\Delta s^e) \tag{11}$$

where W_{us} is U.S. wealth (in U.S. dollars), and W_r is rest-of-the-world wealth (in Canadian dollars), and $W = W_c + SW_{us} + W_r$. With the addition of the assumptions of covered interest parity and rational expectations:

$$s_{+1} - f = a' + b'(B/W) + c'(W_c/W) + d'(SW_{us}/W) - \varepsilon \quad \text{where} \tag{12}$$

$$a' = \frac{a_2}{b} \qquad b' = \frac{-1}{b} < 0 \qquad c' = \frac{a_o - a_2}{b} > 0 \qquad d' = \frac{a_1 - a_2}{b} > 0$$

and ε is an error term.

The signs of c' and d' are given under the assumption that Canadians and Americans hold a greater percentage of their wealth in Canadian assets than do residents of the rest of the world.

We estimate the above equation with two definitions of B for each of two approximations of the distribution of world wealth.[24] The results, as reported in Table 3, indicate that the coefficient on the supply of Canadian outside assets is insignificant, and in three out of four cases is of the opposite sign to that predicted by the theory. Moreover, the coefficients on the relative wealth terms are, in five out of six cases, also not of the expected sign.

Table 3

1971M1 - 1982M11

$$s_{+1} - f = a' + b'\,(B/W) + c'(W_c/W) + d'(W_{us}/W)$$

B includes	a'	b'	c'	d'	S.E.E.	D.W.
Federal debt only	-0.022	0.31	-0.11		0.0131	2.11
	(1.54)	(1.59)	(1.14)			
Federal debt only	-0.67	0.95	-0.045	0.65	0.0131	2.11
	(0.98)	(1.35)	(0.37)	(0.95)		
Fed., prov., mun. debt	-0.019	0.13	-0.012		0.0131	2.11
	(1.20)	(1.03)	(0.15)			
Fed., prov., mun. debt	0.20	-0.049	-0.10	-0.23	0.0132	2.12
	(0.58)	(0.16)	(0.63)	(0.64)		

t-statistics in parentheses

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24. B is defined in the first case to be solely federal debt. In the second case, provincial and municipal debt are added. The distribution of world wealth is approximated in one case by assuming a two-country world and that the Canadian current account represents the transfers of wealth between Canada and the United States. In the other case there is a rest-of-world sector with rest-of-world equal to the sum of the cumulated current account deficits of Canada and the United States. The data are described in Appendix D.

Since earlier work on exchange market efficiency (Longworth et al. (1983)) has found that speculative efficiency ($s_{+1}=f+u$) can be rejected as a model of exchange market behaviour, it is interesting to ask whether a time-varying risk premium of the type discussed above is to some extent responsible. To test this we included asset supply and relative wealth variables in efficiency test equations:

$$\Delta s_{+1} = a_0 + a_1(f-s) + b(B/W) + c(W_c/W) + d(SW_{us}/W) \qquad (13)$$

The relevant equations are shown in Table 4. The results indicate that a_1 is negative and significantly smaller than +1; the inclusion of risk premium variables therefore does not upset the rejection of efficiency in earlier studies. The coefficients on the bond supply are of the wrong sign in three out of four cases and the risk premium variables are generally statistically insignificant.

In summary, there is no evidence of a statistically significant risk premium related to outside asset stocks and the distribution of wealth. Thus there is little indication of a risk premium on the Canadian dollar related to those factors most often discussed in the literature.[25,26] The empirical results here are consistent with the failure to find statistically significant portfolio-balance risk premiums for other currencies, as in Frankel (1979c, 1982c) for the German mark.

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25. Danker et al. (1984) were also unable to find evidence linking a risk premium on the Canadian dollar to the variables suggested by portfolio-balance models.

26. Hodrick and Srivastava (1984) have stressed recently that there are theoretical models in the literature (for example, Hodrick (1981) and Stulz (1981)) in which time-varying risk premiums do not depend (solely) on asset stocks and wealth. Optimizing investors will take into account variances and covariances among all the relevant variables in the system. However, it is admitted that "these models do not lend themselves to easy empirical implementation" (Hodrick and Srivastava (1984)) since the relevant variables need to be clearly specified and limited in number. Although the model we have considered is specific and does not include all possible variables explaining risk premiums, more general models in which there are outside assets are likely to have partial derivatives with respect to outside assets and wealth of the same signs as the model described here.

Table 4

1971M1 - 1982M11

$$\Delta s_{+1} = a_0 + a_1(f-s) + b(B/W) + c(W_c/W) + d(SW_{us}/W)$$

B includes	a_0	a_1	b	c	d	S.E.E.	D.W.
Federal debt only	-0.011	-0.51*	0.18	-0.05		0.0129	2.19
	(0.74)	(0.75)	(0.88)	(0.50)			
Federal debt only	-1.09	-0.78*	1.22	0.07	1.09	0.0128	2.21
	(1.58)	(1.11)	(1.75)	(0.56)	(1.56)		
Fed., prov., mun. debt	-0.014	-0.82*	0.056	0.06		0.0128	2.22
	(0.93)	(1.21)	(0.45)	(0.67)			
Fed., prov., mun. debt	0.14	-0.80*	-0.067	-0.01	-0.16	0.0129	2.23
	(0.41)	(1.17)	(0.23)	(0.05)	(0.46)		

* significantly different from 1 at $\alpha = .05$
t-statistics in parentheses

Frankel (1982a) also attempted to find a risk premium under another type of symmetry, namely that investors all have the same coefficient of risk aversion and optimize by maximizing a utility function which depends on the mean and variance of returns in a portfolio of six currencies, including the Canadian dollar. No statistically significant risk premium was found. Thus, the null hypothesis of perfect asset substitutability was not rejected.

2.4.4 The general two-country model

There are four major ways in which general two-country portfolio-balance models have been implemented for Canada. The first is a model in which the exchange rate is the dependent variable and the stock of net foreign assets and the interest rate differential are important explanatory variables. The second is a model in which the stock of net

foreign assets is the dependent variable. In the third, the exchange rate is the dependent variable and stocks of domestic and foreign money, domestic and foreign asset positions, and (possibly) domestic and foreign bond stocks are the major explanatory variables. The fourth approach, illustrated by Danker et al. (1984), uses the stock of domestic bonds as the dependent variable.

The theory behind the approaches that stress the stock of net foreign assets as opposed to the stocks of domestic and foreign assets individually, is developed in Haas and Alexander (1979) and, more particularly, in Hooper et al. (1982) where it is shown that such an approach can be derived from equations describing the demand for domestic and foreign currency bonds.

The results from models in which the exchange rate is the dependent variable and the stock of net foreign assets is an explanatory variable depend heavily on the time period considered and the proxies used for exchange rate expectations. Haas and Alexander (1979), in a model estimated for the Canadian dollar for the 1953Q3-1961Q4 and 1971Q1-1975Q2 periods using the cumulated stock of net short-term foreign assets, found a significant, correctly signed portfolio-balance effect. Freedman (1979a), however, in a model where relative price levels in Canada and the United States play a role (presumably on expectations), failed to find a significant or correctly signed portfolio-balance effect using a similar stock variable over the 1971Q1-1976Q4 period. Indeed, in much subsequent research at the Bank of Canada, some of which is reported in Section 2.4.5, it has been difficult to find a correctly signed stock variable when relative price (purchasing-power-parity) considerations are taken into account.

Work done at the Board of Governors of the Federal Reserve System in the context of their Multi-Country Model on the Canadian exchange rate for 1970Q4-1980Q2 (Hooper et al. (1982)), shows a correctly signed stock of net short-term assets variable, but it is not significant (t=1.23) and there is no relative price variable in the equation. Experiments done in the context of the annual MACE model of the Canadian economy (Helliwell and Boothe (1982)) show that net liabilities to non-residents as a

proportion of domestic wealth are not statistically significant in an exchange rate equation estimated over the two floating rate periods jointly: 1954-61 and 1971-78. Overall, the approach using the exchange rate as the dependent variable and the stock of net foreign assets as an explanatory variable shows little support for a portfolio-balance effect.[27] The only equation (that of Haas and Alexander) that finds a significant effect does not do so when relative prices are added as an explanatory variable.

One well-known model for Canada that uses the stock of net indebtedness relative to a wealth proxy as a dependent variable in an estimated equation, is the MACE model of Helliwell et al. (1982). The estimated coefficients imply that an increase of one percentage point in the short-term interest rate differential between Canada and the United States would increase net capital inflows by $3.8 billion in the first year, with the cumulative effect being $12.9 billion, when other explanatory variables are set at their 1980 levels.[28, 29]

The third type of empirical model with portfolio-balance features follows the research of Branson, Halttunen and Masson (1977, 1979) in explaining exchange rate movements entirely (or almost entirely) in terms of the asset stocks in basic portfolio-balance models: domestic and foreign money supplies, domestic and foreign net foreign asset positions and (possibly) domestic and foreign bond supplies. Expectations are not modelled explicitly. Models of this type have been estimated by Backus

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27. A further study, by Symansky, Haas and Hooper (1981), was unable to reject the hypothesis of perfect substitutability for the Canadian dollar and three other currencies against the U.S. dollar.

28. The MACE equation does not model exchange rate expectations. Stability in the foreign exchange market is aided by two features of the equation. The first is a portfolio-balance effect resulting from the fact that there are securities denominated in Canadian dollars in foreign portfolios; a fall in the external value of the dollar leads to a drop in the value share of such securities in foreign portfolios and thus to an increased desire to hold Canadian securities. The second is that the difference between the actual trade balance and a measure of its permanent value results in offsetting capital flows. This could be interpreted as stabilizing speculative behaviour.

29. Helliwell and Boothe (1982) showed that in equations where the exchange rate was the dependent variable, the stock of net indebtedness as measured in MACE was not significant. Moreover, the documentation suggests that it was very difficult for the MACE model-builders to find stable equations with reasonable properties for the stock of indebtedness, as the equation changed substantially from Helliwell and Boothe (1982) to Helliwell et al. (1982).

Table 5

EXCHANGE RATE MODELS WITH ASSET STOCKS AS PRINCIPAL EXPLANATORY VARIABLES

Model	Estimation period	Equation (expected signs in brackets above equations)	ρ	D.W.	R^2
Backus (1982)	1971Q1 to 1979Q2	$S = \text{const.} \underset{(6.06)}{\overset{(+)}{+ 0.0188M}} \underset{(8.78)}{\overset{(-)}{- 0.0029M^*}} \underset{(7.87)}{\overset{(-)}{- 0.0060F}} \underset{(4.38)}{\overset{(+)}{- 0.0012F^*}}$		0.92	0.978
Backus (1984)*	1971Q1 to 1980Q4	$S = \text{const.} \underset{(1.43)}{\overset{(+)}{+ 0.975M}} \underset{(1.81)}{\overset{(+)}{+ 1.200B}} \underset{(0.23)}{\overset{(+)}{+ 0.036i^*}} \underset{(4.16)}{\overset{(-)}{- 0.942y}} \underset{(3.69)}{\overset{(+)}{+ 0.752y^*}}$		0.73	0.917
Martin and Masson (1979)**	1973M4 to 1978M4	$1/S = \underset{(4.15)}{1.375} \underset{(1.84)}{+ 0.012M} \underset{(0.24)}{- 0.002M^*} \underset{(0.13)}{- 0.002B} \underset{(1.05)}{- 0.003B^*} + \underset{(1.46)}{0.009F} \underset{(5.69)}{- 0.59QD}$	0.96	1.57	0.95
Frankel (1982b) (i)	1974M2 to 1981M3	$S = \underset{(11.8)}{0.94} \underset{(3.5)}{\overset{(+)}{+ 0.007B}} \underset{(0)}{\overset{(-)}{- 0.00B^*}} \underset{(1.3)}{\overset{(-)}{- 0.005W}} \underset{(0)}{\overset{(+)}{+ 0.00W^*}}$	0.86		
Frankel (1982b) (ii)	1974M2 to 1981M3	$s = \underset{(1.1)}{0.37} \underset{(3.7)}{\overset{(+)}{+ 3.25(B/W)}} \underset{(3.6)}{\overset{(-)}{- 4.08(W/W_T)}} \underset{(1.5)}{\overset{(+)}{+ 0.003\,(W^*/W_T)}}$	0.91		
		$\underset{(0.5)}{\overset{(+)}{+ 0.07(m-m^*)}} \underset{(1.3)}{\overset{(-)}{+ 0.16(y-y^*)}} \underset{(1.6)}{\overset{(+)}{- 0.55(\pi-\pi^*)}} \underset{(2.0)}{\overset{(-)}{- 0.28(i-i^*)}}$			

* Net foreign asset stocks were not significant in this equation.

** Since the expected sign depends on whether Canada is a net debtor or not and instability is implied in the actual net debtor case, signs are not indicated here. The stability and sign problems are discussed in the text.

Note: Lowercase letters are logarithms except in the case of interest rates. U.S. variables are designated by an asterisk. B = bond stock, F = net foreign assets, M = money stock, W = wealth, Y = real output, π = expected inflation, QD = dummy variable for Quebec election of 1976.

t-statistics are in parentheses below equations

(1982, 1984), Martin and Masson (1979), and Frankel (1982b). Their results are shown in Table 5.

Backus (1982) estimates an equation that is closest to the spirit of the original Branson et al. work.[30] He finds that the coefficient on the U.S. net foreign asset stock is incorrectly signed. In addition, the low Durbin-Watson statistic indicates misspecification. An extension of his work (Backus (1984)), shows that asset stocks tend to be insignificant when Canadian and foreign income are entered in the equation, along the lines justified by Obstfeld (1983).

Martin and Masson replace the two net foreign asset variables of the Branson et al. model with the stocks of domestic and foreign bonds and the bilateral net foreign asset position. Their results are disappointing in that out of all the coefficients on the stock variables, only the coefficient on the Canadian money stock is significant. Moreover, an increase in the Canadian money stock causes an appreciation of the Canadian dollar. Although the authors show that this is what the portfolio-balance theory predicts for a net debtor country like Canada when there is no feedback through expectations, it is clear that stability problems would be severe.[31] Martin and Masson conclude that their estimation results are mediocre and give an unfavourable verdict on the empirical utility of the portfolio-balance model.

Frankel (1982b) aggregates money and bonds into assets denominated in domestic currency and assets denominated in foreign currency. His results are not particularly encouraging, although the Canadian variables do have the correct sign. Frankel proceeds to integrate the portfolio-balance model into a monetarist model of the Frankel (1979b) type. The results are surprising in that the portfolio-balance terms are now all correctly signed, but the elements of the equation that come from the monetarist model are generally insignificant (with the exception of the interest rate differential), and two are of the wrong sign. Since this synthesis is not

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30. Backus notes that this formulation omits bond supplies and the foreign interest rate, which theoretically belong in the equation. Tryon (1983) refers to the Branson et al. specification as "ad hoc, since it cannot be derived from the authors' model".

31. Stability in the net debtor case is further discussed by Masson (1980,1981) and Henderson and Rogoff (1982).

successful and since the portfolio-balance models do not work extremely well on their own, Frankel puts little weight on his portfolio-balance models.

Danker et al. (1984) obtained no support for a portfolio-balance model for Canada in which the stock of Canadian dollar outside bonds was the dependent variable.

When there is imperfect asset substitutability and the demand for bonds changes with wealth shifts that come through the current account, the response of the current account to exchange rate changes is important in determining the dynamics of exchange rate movements over time. Thus, in Appendix C we survey the evidence on some elements of the response of the current account to exchange rate changes.

2.4.5 Imperfect substitutability in the short run only

The models that we have examined to this point are largely equilibrium models in the sense that asset market adjustment takes place within the period examined. It may be, however, that there are 'digestion effects' in the asset markets we are considering which require that rates of return move in the short run to accommodate changes in supply, but once these supply changes have been incorporated, the rates return to their normal values vis-à-vis rates of return on other assets.[32]

In the context of the foreign exchange market, a requirement that foreigners hold more claims on domestic residents might lead to a depreciation of the Canadian dollar relative to its expected value for a period of time, but then the dollar would recover once the rate of increase in these claims fell to zero.

This is a feature of the exchange rate equation used in the RDXF model of the Canadian economy.[33] An exchange rate equation of the form that has been used in the RDXF model is as follows:

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32. Charles Freedman has described certain phenomena in domestic financial markets in this way. See Freedman (1981).

33. The RDXF model, with the exception of the exchange rate equation, is described in Robertson and McDougall (1982a,b).

$$s = s_{-1} - .0074 - .43\,(i-i^*)/100 - .80\,(UBAL/Y)$$
$$\qquad\quad (3.24)\quad (5.17)\qquad\qquad (3.45)$$

$$+ .14\,(ppp-s_{-1}) + .10\,(ppp-s_{-1})\,D1$$
$$\qquad (5.70)\qquad\quad (4.60)$$

$$- .26\,(\Delta(X-M)/Y)_{-1} - 1.46\,(\Delta(FIL)/Y)_{-1}$$
$$\qquad (1.63)\qquad\qquad\quad (5.09)$$

$$- .044\,(poil - p^*) - .024\,DHIBERNIA$$
$$\qquad (4.98)\qquad\quad (4.46)$$

$\bar{R}^2 = 0.993$ S.E.E. = 0.0066 D.W. = 1.96 (1971Q1-1981Q3)

where UBAL = the basic balance (at quarterly rates),
Y = nominal GNP
X-M = the seasonally adjusted trade balance (at annual rates),
FIL = the long-term capital account balance (at quarterly rates),
poil-p* = the real price of oil in the United States in logarithmic terms,
ppp = a purchasing-power-parity measure of the exchange rate represented by the logarithm of the ratio of a four-quarter moving average of the Canadian GNE deflator to a four-quarter moving average of the U.S. GNE deflator,
D1 = 0 until 1976Q4, 1 thereafter, and
DHIBERNIA = 0, except + 1 in 1980Q1, -1 in 1980Q2.

The basic theory behind the exchange rate equation is as follows:

(i) the long-run elasticity of the exchange rate with respect to ppp is 1;
(ii) the nominal interest rate differential affects the exchange rate;
(iii) the accumulation of net foreign assets (a basic balance surplus) tends to cause the Canadian dollar to appreciate; and
(iv) surprise announcements about the merchandise trade balance, the long-term capital account, the real price of oil (as proxied by the changes in those variables), and offshore oil discoveries in the first half of 1980 have short-run effects on the exchange rate.

This type of equation resulted from a search of specifications to obtain a good forecasting model rather than to test a specific exchange rate model so that the values of the t-statistics are likely to be

severely overstated. In particular, the inclusion of an increase in the speed of adjustment to purchasing-power parity at the end of 1976 was motivated by the empirical observation that the exchange rate became less sluggish in its movement at that point.

The implication of the estimated coefficient on UBAL in the exchange rate equation is that in order for foreigners to hold an additional $1 billion in claims against Canadians (within a quarter) would have required a temporary depreciation of the Canadian dollar by 0.22 per cent (calculated on the basis of 1982 values for other variables). Under the assumption that a dollar of intervention has the same effect as an increase in the basic balance, the effects of intervention on the exchange rate are small [34] and die out quite rapidly. [35]

2.4.6 Evidence from other Canadian macroeconometric models

In addition to the evidence from the MACE and RDXF econometric models, we have evidence from the following large Canadian macroeconometric models: CANDIDE 2.0, DRI, FOCUS, the MTFM of the Conference Board and the Bank of Canada's Small Annual Model (SAM). [36] Since the documentation available to us on exchange rate determination in these models is often not extensive, we simply provide an overview of their evidence. Table 6 describes some of the main features of these models.

In common with RDXF, there are no portfolio-balance (stock) effects on the exchange rate in CANDIDE or in the FOCUS model (where one can think of the short-term capital flow equation as determining the exchange rate). The flow effects in CANDIDE, an annual model estimated up to 1975

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34. The amount of the basic balance offset by intervention is not taken into account explicitly in the equation. Since intervention has followed a 'leaning-against-the-wind' rule in which it is approximately linearly related to the change in the exchange rate (see Longworth (1980a)), its coefficient would suffer simultaneous equations bias. Moreover, it may not be possible to identify it econometrically (see Longworth et al. (1983) Appendix E).

35. Since there is a lagged dependent variable in the equation, the effects last longer than one quarter.

36. CANDIDE 2.0 is the model of the Economic Council of Canada (1979). DRI is the model of Data Resources Incorporated. FOCUS is the model of the Institute for Policy Analysis (1980). SAM is an annual model of the Bank of Canada (for an overview see Rose, Selody and Masson (1982)).

(and thus using only 5 1/2 observations from the current float), are insignificant.

Table 6

SUMMARY OF EXCHANGE RATE EQUATIONS IN CANADIAN MACROECONOMETRIC MODELS

Model	Model/equation estimated to	Stock effect	Flow effect only	Dependent variable	Periodicity
CANDIDE 2.0	1975	No	Yes (Insignif-) icant)	Exchange rate	Annual
DRI	?	Yes		Exchange rate	Quarterly
FOCUS	1977	No	Yes	Flow	Quarterly
MTFM	1979	Yes		Exchange rate	Quarterly
SAM	1981	Yes		Expected rate of return on foreign assets	Annual
MACE	1980	Yes		Stock to wealth	Annual
RDXF	1981	No	Yes	Exchange rate	Quarterly

The quarterly models MTFM and DRI, like CANDIDE and RDXF, use equations normalized on the exchange rate for estimation purposes. The DRI equation resembles the Haas-Alexander model with a dummy for the rapid depreciation of the Canadian dollar following the Quebec election of 1976. The MTFM model is essentially the Haas-Alexander model in first-difference form, with a dummy for the Quebec election of 1976. Neither model contains a relative price (purchasing-power-parity) term, which is found to be highly significant in RDXF. We have verified that stock variables

are insignificant or wrongly signed in MTFM-type and Haas-Alexander-type equations for sample periods ending in 1976Q4 and later, particularly when relative price terms are added.[37]

SAM, the Bank of Canada's annual model, like the MACE model, has a portfolio-balance equation which is normalized on the expected rate of return on foreign assets. This equation is part of a larger demand system which determines the distribution of financial wealth across the various categories of financial assets. Interest rate differentials, expected inflation and the deviation of the price of foreign exchange from its expected price determine the proportion of net foreign assets in the portfolio. For estimation purposes, the expected level of the price of foreign exchange is proxied by the forward rate.

2.4.7 Stability of equations and conclusions

Exchange rate equations for most major currencies have been statistically unstable for the generalized float since 1973 (see Meese and Rogoff (1983)). In the case of the Canadian dollar, this has been borne out by the changes in specification that occurred in the RDX series of models as equations were found to be unstable when additional data were added. Moreover, equations solved for capital flows (or stocks) do not appear to have fared better, in that dummy variables have often been entered to explain 'anomalies' in particular quarters. This instability means that we can be less sure of the estimated coefficients than is indicated even by their standard errors; in short, we do not have a solid empirical basis for our exchange rate theorizing. This might well arise from unstable expectations in exchange markets such as those caused by

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37. Expectations of future exchange rates need not depend solely on past exchange rates (and intervention) as in the basic Haas-Alexander model. If expectations depend on the expected purchasing-power-parity level of the exchange rate, which in turn depends on past relative prices, then such relative prices should be included in the specification of the exchange rate equation. For example, the basic format for the RDXF equation can be derived from the following (where e denotes expectations):

$s^e - s = \lambda(ppp^e - s)$
$ppp^e = \theta ppp + (1-\theta)s_{-1}$
$s^e - s = i - i^* - c(UBAL/Y)$, where c is a coefficient.

erratic shifts of attention from one variable to another and so on.[38,39]

To summarize, since the results discussed in this chapter indicate that movements in risk premiums related to asset stocks and wealth cannot account for many of the systematic divergences observed between future spot rates and forward rates, in our opinion they lend support to the view that there is inefficiency in the exchange market. This means that there may be grounds for policies to offset exchange market disturbances, including official exchange market intervention to the extent that it is effective.

The evidence that we have surveyed does not generally reject the hypothesis of perfect substitutability over periods longer than a quarter. Even if risk premiums do exist, it is not likely that they are very important economically. The failure to find substantial evidence in favour of a portfolio-balance model means that a major channel whereby official exchange market intervention might affect the value of the Canadian dollar is not available to the authorities; intervention apparently has a longer-run effect only to the extent that it can influence expectations. This implies that intervention would ultimately have to be supported by other, more basic, policies to achieve longer-run exchange rate objectives; otherwise it ceases to be a credible instrument. However, since there is some evidence of imperfect substitutability in the short run, intervention might well be an effective short-run smoothing device for the exchange rate.

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38. Recent work has given some emphasis to 'irrational' phenomena such as fads and bandwagon effects. See, for example, Blanchard (1979) and Dornbusch (1983).

39. Shifts in foreign or domestic policy or in the demand for money could also be a factor at times.

CHAPTER 3

MODELS OF MONETARY POLICY AND SHORT-RUN FISCAL POLICY UNDER FLEXIBLE EXCHANGE RATES

3.1 Introduction

The channels through which monetary policy affects inflation and output in open economies are more varied than those in closed economies. In particular, movements in nominal exchange rates (when not responding to movements in foreign prices) will be associated with changes in the domestic price level, and movements in real exchange rates (the nominal exchange rate adjusted for movements in domestic and foreign price levels) will affect output. A high degree of asset substitutability would mean that monetary policy would no longer work to affect output primarily through changes in real interest rates (as in closed economies). However, the real exchange rate channel means that under flexible exchange rates an increase in the degree of substitutability will likely increase the effect of changes in monetary policy on output. One consequence is that the effect of monetary policy on prices will also be increased, first through the output effect on wages and prices and second, through the impact of the exchange rate change on the prices of tradable goods.

If domestic and foreign monetary policy move in the same direction by equivalent amounts, the exchange rate channel no longer operates; monetary policy affects real output only to the extent that real interest rates change. Changes in foreign monetary policy alone, by contrast, will initially have their largest impact on the domestic economy through a change in the exchange rate.

In our discussion we will focus on the short and medium run. It is in that time horizon that the degree of capital substitutability can affect the degree of influence that money has on real activity. In the classical flexible-price model, money is neutral in long-run equilibrium regardless of elasticities of substitution between assets. Thus we can assume that, over time, changes in the rate of monetary expansion affect primarily the rate of inflation and that any effects on output are essentially independent of capital substitutability.

A high degree of substitutability of capital tends to reduce the short-run effect of a given fiscal initiative on the level of output since it leads to a larger exchange rate change and therefore a greater offsetting change in net trade volume. However, even in the presence of perfect substitutability, fiscal policy can influence the level of output in the short-to-medium run except in models that make extreme assumptions about wage and price inflexibility and/or exchange rate expectations.

In the first analytic section of this chapter (3.2), we examine theoretical models in which domestic and foreign residents hold each others' bonds but only hold currency issued by their own countries. We start with the traditional Mundell-Fleming model and then proceed to vary some of the assumptions. The traditional classical and new-classical rational expectations models are also examined theoretically. In Section 3.3, empirical evidence from Chapter 2, together with some empirical evidence on the movements in real exchange rates and real interest rates, is examined to provide an indication as to which theoretical models are more relevant. The assumption that residents hold only their home currency is relaxed in Section 3.4 where we examine currency-substitution models theoretically and empirically. Section 3.5 draws out and summarizes the conclusions on the effects of Canadian monetary policy and short-run fiscal policy given the degree of asset substitutability found.

3.2 Theoretical Models Under Flexible Exchange Rates

3.2.1 The basic Mundell-Fleming model

The basic Mundell-Fleming model (Mundell (1963), Fleming (1962)) extends the Keynesian IS-LM framework to the open economy. Wages and prices (with the exception of import prices) are sticky in nominal terms, so the economy need not be at full employment, and the LM curve is the same as in a closed economy. The position of the IS (goods market) curve in interest rate/output space depends on the exchange rate, since the volume of net exports depends on the relative prices of domestic and foreign goods. Equilibrium in the balance of payments (usually denoted in

diagrams by an FF or BP curve) occurs when the current account, which is a function of income and the exchange rate, plus the capital account, which depends on the interest rate differential between the home country and the foreign country (since exchange rate expectations are static), equals zero. (See Figure 3.1.)

3.2.1 (a) Monetary policy

In the limiting case of perfect capital mobility and substitutability, the balance of payments can be in equilibrium only when the domestic interest rate equals the foreign interest rate. This condition is represented by a horizontal line at the level of the foreign interest rate (Figure 3.2). In this case, nothing impedes the effect of monetary policy under flexible exchange rates -- a shift to the right of the LM curve (Figure 3.3) requires an exchange rate depreciation large enough to lead to an equal rightward shift of the IS curve. In static equilibrium, output rises without a change in domestic interest rates.

If capital movements are not infinitely elastic with respect to the interest rate differential, however, the balance of payments curve will have some upward slope to it because the deterioration of the current account due to higher imports from higher output levels needs to be offset by higher capital inflows induced by higher interest rates (Figure 3.1). Expansionary monetary policy (Figure 3.4) will be associated with a decline in the domestic interest rate (where L'M' intersects IS) and an incipient balance of payments deficit which will engender a depreciation of the domestic currency (and a fall in BP to B'P' and a rise in IS to I'S'). In equilibrium, output will have increased, interest rates will have fallen, and the exchange rate will have depreciated. Monetary policy will be more expansionary the greater the substitutability between domestic and foreign capital.[1]

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1. This can be seen by differentiating expression 15 in Fleming (1962, p. 378) with respect to X_r.

BASIC MUNDELL-FLEMING MODEL

Figure 3.1
Imperfect Asset Substitutability

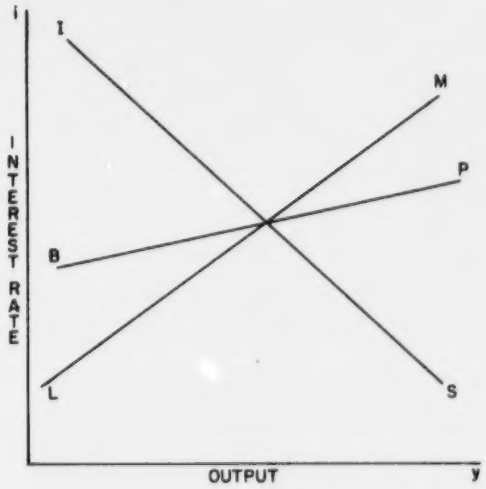


Figure 3.2
Perfect Asset Substitutability

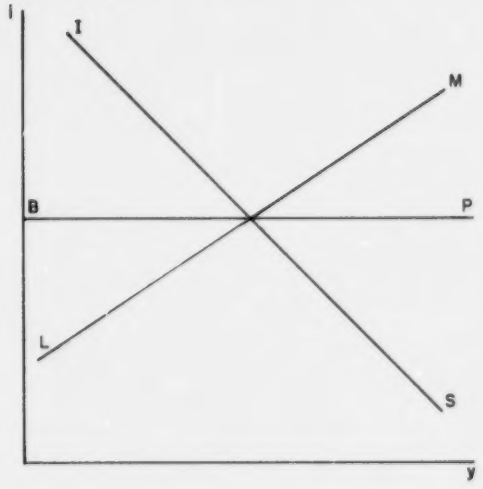


Figure 3.3
Expansionary Monetary Policy
With Perfect Asset Substitutability

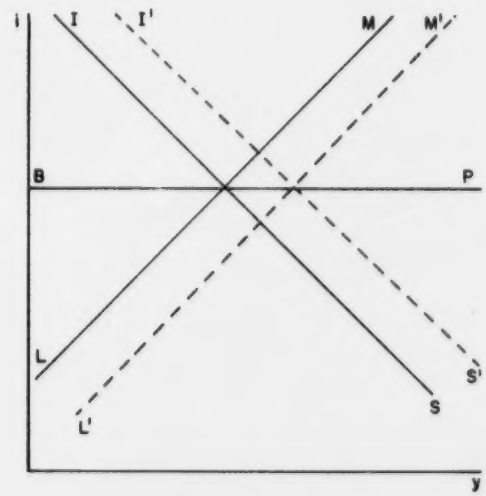
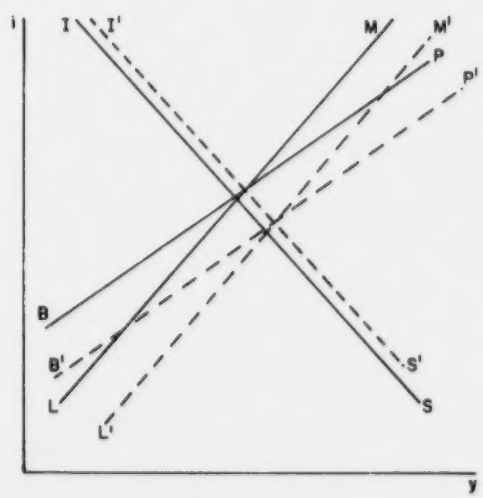
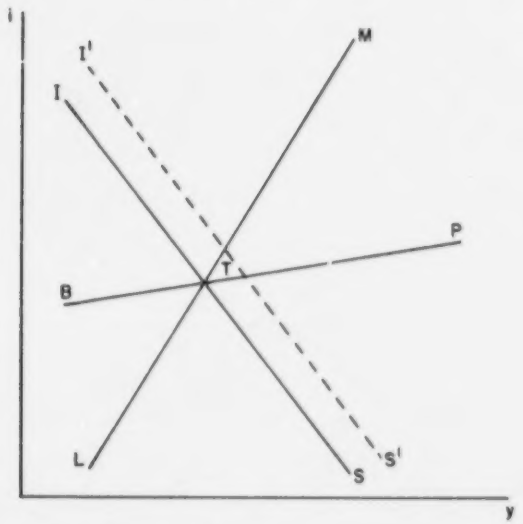


Figure 3.4
Expansionary Monetary Policy
With Imperfect Asset Substitutability



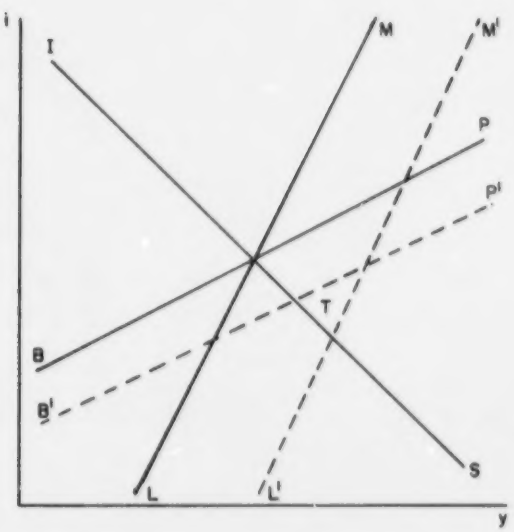
BASIC AND EXTENDED MUNDELL-FLEMING MODEL

Figure 3.5
Expansionary Fiscal Policy



EXTENDED MUNDELL-FLEMING MODEL

Figure 3.6
Expansionary Monetary Policy
(Open-market operation)



3.2.1 (b) Fiscal policy

In the Mundell-Fleming model with perfect capital substitutability, fiscal policy is incapable of changing output under flexible exchange rates. Changes in the exchange rate induce an exact trade balance offset to fiscal policy because with perfect mobility, any change in the government deficit is fully financed through the capital account of the balance of payments.[2] To maintain equilibrium in the balance of payments, the trade account must move by the same amount in the opposite direction. This is achieved by an appropriately large movement in the exchange rate. An expansionary fiscal policy results in a larger current account deficit and an appreciation of the exchange rate, but no change in the level of output. Since the rate of interest is unchanged there is no crowding out of domestic investment (or consumption). It is the trade balance that is crowded out (i.e., net investment abroad). In the perfect substitutability case, Figure 3.3 can do double duty to illustrate pure fiscal policy. Since neither the horizontal BP line nor the LM schedule shift, the equilibrium given by the original intersection of the two is not changed. Likewise, the IS schedule remains in its original position.

In the more general case analyzed by Fleming, where assets are less than perfect substitutes, fiscal policy has more potency. An increase in government spending is not completely financed through the capital account of the balance of payments, hence domestic income rises to provide the required savings. Also, the rate of interest rises, leading to some crowding out of domestic investment spending. Figure 3.5 illustrates this case. The IS curve shifts to the right, inducing an increase in the interest rate and a decrease in the price of foreign exchange. For balance of payments equilibrium at a lower price of foreign exchange, the BP schedule must shift vertically. The new equilibrium is bounded by triangle T.

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2. This prediction is also made by the 'Cambridge model' of the U.K. economy (Cripps and Godley (1976)). However, in this model the result is apparently due to behaviour attributed to sectors within the United Kingdom, rather than to perfect capital mobility.

3.2.2 Extensions of the Mundell-Fleming model

Over the two decades since the Mundell-Fleming model was first proposed, a number of its weaknesses have been noted and a number of suggestions have been made to make its assumptions more realistic.[3] First, it was noted that in the imperfect substitutability versions of the model, it is capital flows that respond to interest rate differentials, and not stocks. This, however, affects the dynamics of the model and the long-run outcome, but not the initial effects. Second, it was noted that expectations were static, so there was no way in the perfect capital substitutability version of the model for the domestic interest rate to differ from the foreign interest rate.[4] Third, the price index used to deflate aggregate demand and the demand for money was the domestic price, rather than a composite price index incorporating domestic production and imports. Fourth, inflation is ignored. Finally, the model was overly restrictive in fixing domestic prices when all that was necessary was to fix the nominal domestic wage and let production depend on the real wage paid by firms.

Marston (1984) analyzes a modified Mundell-Fleming model which incorporates a portfolio-balance model, inflation, regressive price and exchange rate expectations, a composite price index, and a fixed nominal wage (rather than a fixed domestic price level). In addition, wealth is allowed to affect aggregate demand and the demand for money.

3.2.2 (a) Monetary policy

Marston's findings for monetary policy are quite similar to the Mundell-Fleming results: an increase in the domestic money stock leads to an increase in output, a decline in the interest rate (except in the case of perfect capital mobility and static expectations), and an exchange rate

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3. A number of these are noted in Marston (1984) and Branson and Buiter (1982).

4. See Argy and Porter (1972) and Dornbusch (1976b).

depreciation (except in an unlikely case).[5] (These findings are illustrated in Figure 3.6 where open-market operations initially shift LM to L'M' and BP to B'P'; after the depreciation causes further shifts in the curves, the equilibrium impact effect will lie in the triangle labelled T.) In addition, domestic prices rise to induce the necessary increase in output and the overall composite price index rises as well since import prices rise with the exchange rate depreciation.

In the case of perfect capital mobility and static expectations, we are back in the traditional Mundell world with no change in the domestic interest rate. However, the fact that expansionary monetary policy leads to a decline in the domestic interest rate (both nominal and real) when one introduces regressive exchange rate expectations in a model with perfect substitutability, implies that the modelling of those expectations is important. Thus, the expectations process can open up another channel for changes in domestic monetary policy to affect domestic output and prices.

Dornbusch (1976a) and Frankel (1979b) have described models with perfect capital substitutability, sticky prices (inflation rates in Frankel's case), and rational exchange rate expectations. Although these models (in their main cases) are presented under the assumption of fixed output, the overshooting pattern of the exchange rate that they exhibit (in which the exchange rate depreciates more in the short run than in the long run) in response to an expansionary monetary shock, implies that if output were endogenously determined, it would be affected less here than in a model where exchange rate expectations were static. This result occurs because with prices fixed, income and interest rates must adjust to clear the money market. Therefore, the more interest rates fall in response to an increase in the money stock, the less output needs to rise (and the less exchange rate depreciation is required). Thus, by retaining the assumption of sticky prices, one finds that non-static expectations imply lower output response to expansionary monetary policy than the traditional Mundell-Fleming model.

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5. This case cannot occur when there is high capital substitutability or a low expenditure elasticity with respect to interest rates.

3.2.2 (b) Fiscal policy

In modern portfolio-balance models, changes in the stock of bonds outstanding move the economy from one instantaneous equilibrium to another. In this way, the effects over time of budget imbalances are made explicit. The impact effects of fiscal policy in these models turn out to be similar to those derived by Mundell and Fleming, the main difference being that in a portfolio-balance model, a fiscal expansion causes the exchange rate to appreciate when there is less than perfect substitutability, whereas the exchange rate effect is ambiguous in Fleming's model (Marston (1984)). In Figure 3.5, just as in the simple Mundell-Fleming model, there is a rightward shift in the IS curve and a new equilibrium within triangle T.

Changing the assumption of static expectations can modify more significantly the Mundell-Fleming results. Consider an expansionary fiscal policy that puts initial upward pressure on the domestic interest rate and downward pressure on the price of foreign exchange. If expectations are regressive or adaptive, a decrease in the price of foreign exchange would on its own induce a capital outflow because there would be expectations of an increase back to the original level. The decline in the price of foreign exchange is thereby moderated and the trade balance does not decline by the full extent of the increased budget deficit. (In diagramatic terms, the horizontal BP line of Figure 3.3 shifts upward vertically by the amount of the expected increase in the price of foreign exchange.)

This example is of practical interest because well-known econometric models[6] for Canada do implicitly embody adaptive exchange rate expectations.[7] Although it cannot be claimed that the estimated coefficients in the exchange rate equations of these (large Canadian) models are stable, the important point here is the robustness of the finding that expectations for the Canadian dollar are adaptive.

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6. For example, DRI, MTFM, and RDXF.

7. Cf. Chapters 2 and 4.

Further theoretical refinements of the Mundell-Fleming approach related to fiscal policy are: (i) the wealth effect of bond issues; (ii) the wealth effect of exchange rate changes; and (iii) the terms-of-trade effect on aggregate demand. Since these both individually and in total are not likely to be of much practical significance they can be dealt with briefly:

(i) With perfect capital substitutability and static exchange rate expectations, government bond issues do not increase bond holdings by domestic residents. Hence, there is no wealth stimulus to private spending. This effect is in any case theoretically controversial (Barro (1974), Tobin and Buiter (1980)). Moreover, a wealth effect on the demand for money would work in the opposite direction. With wealth effects in both goods and money markets, increased government spending financed by bonds shifts the LM curve to the left while it shifts the IS curve to the right. (ii) An increase in the exchange value of the Canadian dollar reduces net indebtedness and debt service payments to foreigners which would increase aggregate demand. This effect cannot be large since the propensity to consume from wealth is not greater than the interest rate according to the permanent income hypothesis of Friedman (1957), and since net foreign currency liabilities are a small proportion of privately held wealth. For example, net interest-bearing foreign currency liabilities amount to no more than 25 per cent of annual GNP, and the real rate of interest is rarely above 6 per cent. Therefore, the maximum effect through this channel of a permanent 10 per cent appreciation would be to increase consumption by 0.15 per cent of GNP (25 per cent x 0.06 x 0.1). (iii) For a large country, a decrease in the price of foreign exchange brought about by an expansionary fiscal policy causes the terms of trade to improve if prices are sticky. This raises real disposable income at a given level of output. Laursen and Metzler (1950) hypothesized that this increases desired saving, tending to moderate the effect of the policy. Again, this effect could not be very strong for a country like Canada where both import and export prices are quite sensitive to the exchange rate.

3.2.3 Classical model results

In contrast to the sticky-wage or sticky-price assumptions that are used in models of the Mundell-Fleming tradition, classical models assume full price and wage flexibility, and thus are characterized by full employment. If labour supply responds to the real consumption wage (nominal wage divided by a composite index of domestic and imported product prices) and labour demand responds to the real product wage (nominal wage divided by the price of domestic output), then employment and production will be positively related to the domestic price relative to the price of imports (the terms of trade in a two-good model).

A special case of this model occurs when domestic and foreign goods are perfect substitutes, so that the law of one price holds. In this case, output is independent of monetary policy because the terms of trade are constant. This result is independent of the substitutability of domestic and foreign assets, and stands in stark contrast to the results of the Mundell-Fleming sticky-price models.

When domestic and foreign goods are not perfect substitutes, the results are more difficult to characterize precisely. They depend on the real wealth effects on aggregate demand and the portfolio-balance features of the model. Generally, however, the output effects of an expansionary monetary policy are small, and can be negative.[8,9]

3.2.4 New-classical macroeconomics — rational expectations models

Models of the 'new-classical' macroeconomics type, developed in the 1970s and 1980s, generally assume that: (i) anticipated changes in money have no real effects, and (ii) expectations are formed rationally.

Marston (1984) describes a model of the new-classical type in which aggregate supply depends positively on unexpected changes in the domestic price (since wages are fixed during the period at the level expected to

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8. Marston (1984) shows that the effect can be negative in certain cases when real wealth affects aggregate demand and assets are perfect substitutes internationally.

9. Fiscal policy in a classical model is considered in Chapter 5.

clear the labour market) and positively on the expected terms of trade (which enter for the same reason as in the classical model). Aggregate demand depends on the actual terms of trade, the expected real interest rate (in terms of the consumption bundle), and foreign income. Real money balances in terms of the consumption bundle are positively related to domestic real income and negatively related to the interest rate. The model is examined for the case of perfect asset substitutability.

On impact, a temporary unanticipated increase in the money supply leads to a depreciation in the exchange rate and an increase in both output and the domestic price level. As well, the domestic interest rate declines. All these effects, which parallel those of the extended Mundell-Fleming model and arise because of the sticky-wage and endogenous exchange rate expectations assumption, last only one period. Qualitatively the same effects on the exchange rate, output, and the domestic price level arise in the case of an unanticipated permanent increase in the money supply. However, there is a lasting permanent increase in the domestic price level and a lasting permanent depreciation of the currency, just as in the classical model.

Henderson (1982) described a model similar to the above, but allowed for imperfect substitutability between domestic and foreign assets. Under the most plausible parameter values, an unanticipated increase in the money supply leads to a depreciation of the currency, an increase in the domestic price level and an increase in output.[10] The output increase is again temporary, whether or not the increase in the money supply is permanent or temporary.

Because of the way these models are usually set up, they allow fiscal policy to affect neither the price level nor the level of output. It would doubtless be possible to manufacture short-run output effects through assumptions about the wealth and terms-of-trade effects explained above, but such an exercise is hardly worthwhile. Otherwise the neutrality propositions are independent of the degree of capital substitutability.

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10. These effects are also found in a similar model by Eaton and Turnovsky (1982).

One implication of the new-classical models is that monetary actions pursued systematically do not even have a short-run effect on output. Since in this case only unpredictable changes in policy affect output, discretionary policy changes may increase the variance of output and relative prices around equilibrium levels.

3.3 Implications of the Theory in Light of the Empirical Evidence

The empirical evidence presented in Chapter 2 indicated that the hypothesis of perfect capital substitutability for short-term assets was difficult to reject, outside of short-run digestion effects. Thus, in terms of the basic Mundell-Fleming model under flexible exchange rates, conditions are right for monetary policy to have its maximum short-run impact on output. However, if one augments that model with a Phillips curve relationship and with a direct link from import prices to domestic prices, these are the same conditions necessary for the maximum eventual effect of monetary policy on the price level, since the depreciation required to effect the increase in output will be at its maximum.

In this section we consider the implications of further empirical studies on real interest rates, real exchange rates and the inter-relationship between exchange rate and interest rate movements. The framework of analysis is the extended Mundell-Fleming model with perfect capital substitutability and non-static exchange rate expectations. We do not describe the dynamic effects of monetary policy in the economy, although these factors must be borne in mind when examining policy implications, as we do in Section 3.5.

3.3.1 Studies of real interest rates

Mishkin (1982, 1984) studied the movements in real interest rates (under the rational expectations hypothesis) in a group of seven industrialized countries. Using Euromarket interest rates and both consumer price and wholesale price indexes, he found that the empirical

evidence strongly rejects the equality of ex ante real rates across the seven countries for the 1967Q2-1979Q2 period as well as for the shorter flexible rate period from 1973Q3 to 1979Q2. In addition, for the group of countries as a whole, he found that the constancy of ex ante real rates can easily be rejected.[11] In particular, real rates decline with higher beginning-of-period inflation and money growth.

The individual equations for the Canadian real rate indicated that the ex ante rate was not constant and was significantly and negatively related to the observed beginning-of-period inflation rate. The real rate is also negatively related to beginning-of-period money growth, but not significantly so.

This empirical evidence tends to indicate that real interest rates are not equalized across countries in the short run, and thus, if there is perfect capital mobility, exchange rate expectations are not solely related to expected inflation differentials among countries.[12] In addition, it appears that monetary policy can change real interest rates, at least in the short run, as would be the case in a sticky-price model.

3.3.2 Studies of exchange rates — implications for the real exchange rate

The Canadian real exchange rate (nominal exchange rate adjusted for relative price movements) vis-à-vis the U.S. dollar has been very volatile during the recent floating exchange rate period. (See, for example, Freedman and Longworth (1980) and Longworth (1983).) Thus, a classical purchasing-power-parity (PPP) model does not explain the medium-term swings in the exchange rate, although there appears to be a tendency for

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11. Although for the period as a whole, Mishkin states that the equality of real rates cannot be rejected for Canada, the United States and the United Kingdom as a subgroup, no such statement is made about the floating exchange rate period.

12. If real interest rates are not equalized, we may write $i - \pi^e \neq i^* - \pi^{*e}$ where π denotes the rate of inflation. Perfect capital mobility implies $i = i^* + \Delta s^e$. Thus $\Delta s^e \neq \pi^e - \pi^{*e}$.

the exchange rate to move towards its PPP value in the long run.[13]

Deviation of the exchange rate from its PPP value could be due to real factors (such as a change in saving or investment behaviour), monetary factors, or informational lags (perhaps combined with behaviour that is not fully rational in the context of 'mechanical' rational expectations models). Monetary factors have been shown empirically to play a major role in short-run movements of the Canadian nominal exchange rate. Since relative price levels move slowly, this also means that monetary factors have at least a short-run effect on real exchange rates. Monetary factors often enter the exchange rate equation in the form of nominal interest rate differentials between countries such that an increase in the nominal interest rate differential in favour of Canada is associated with an appreciation of the Canadian dollar (see, for example, Haas and Alexander (1979) and Freedman (1979a)).[14] This appears to be the case regardless of whether relative money stocks or relative inflation rates enter the equation (see Frankel (1982b) and Backus (1982)), and therefore supports a sticky-price view of the world rather than a combined monetarist-flexible-price view.

3.3.3 Exchange rates and interest rate differentials: Correlation and causation

In addition to the evidence from the above-mentioned econometric models that an increase in the interest rate differential in favour of Canada is associated with an appreciation of the Canadian dollar, there is similar evidence in the work of London (1981) and Longworth (1981b), (1983). London shows that during the 1971-79 period, when the Canadian Bank Rate was changed only sporadically, announced changes in the Rate had

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13. This is evidenced by the fact that one cannot reject a long-run coefficient of one on the purchasing-power-parity term in the RDXF-type exchange rate equation described in Chapter 2. Additional supporting evidence is provided by the coefficients on the current purchasing-power-parity value of the exchange rate in the equations testing exchange market efficiency in the study of Longworth et al. (1983).

14. These studies look at the contemporaneous relationship between the interest rate and the exchange rate rather than the relationship between the beginning-of-period interest rate and the change over the period in the exchange rate. Thus they do not provide direct evidence on uncovered interest parity and/or rational expectations.

effects in the same direction on the value of the Canadian dollar. These effects were statistically significant in the case of Rate increases and, although not significant, were of the same economic order of magnitude in the case of Rate decreases. Since the Bank Rate changes were announced following market close one day and prior to market opening the next, the path of causation is clear. Longworth (1983) showed that in the context of a rational expectations term structure model, surprises in the interest rate differential (as proxied by the forward premium) lead to effects on the exchange rate of the same sign as in London, although the effects were not statistically significant. However, in Longworth (1981b), where the assumption of a rational expectations term structure is not made, the effects were found to be significant.

3.4 Currency Substitution

3.4.1 Some theoretical aspects of currency substitutability

The hypothesis of currency substitutability (CS) implies that investors want to hold foreign currencies as well as domestic currencies in their portfolios and that the demand for these currency balances will be adjusted in response to conditions of risk and opportunity costs.[15] In many models (for example, Miles (1978), Brillembourg and Schadler (1979)) it is presumed that asset-holding decisions proceed in two stages: first, investors decide on the share of the portfolio that will be allocated to real cash balances and second, the cash balances are divided between domestic and foreign currencies.

The theoretical implications of the CS hypothesis have been examined in many papers (see, for example, Calvo and Rodriguez (1977), and Girton and Roper (1981)). Some authors have shown that under certain conditions currency substitution would result in exchange rate instability and, in the limit of perfect substitutability, in exchange rate indeterminacy. McKinnon (1982) has argued that substitutability is in fact sufficiently

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15. In the standard portfolio-balance models, it is assumed that investors hold domestic currencies, domestic-currency-denominated bonds and foreign-currency-denominated bonds but they do not hold foreign currencies. This last assumption is relaxed here.

high to justify a coordinated international money growth target. In the presence of currency substitution, it becomes harder to achieve a domestic inflation rate different from the world inflation rate. With perfect substitutability, Miles (1978) notes: "An increase in the nominal money supply in either country will increase the real balances used in both countries and cause the price level in both countries to rise by precisely the same amount." (p. 432).

The CS hypothesis also has implications for the specification of the demand for money. In particular, the rate of return on foreign currency, which is the expected rate of depreciation of the domestic currency (proxied by the forward premium), should be included in the demand for domestic money. Poloz (1982) has shown that if domestic money is held by non-residents, other variables must also be included: foreign real income, the foreign nominal interest rate, and the real exchange rate.

Substitutability among currencies will also have an effect on exchange rate determination. Brillembourg and Schadler (1979) explain it this way: "Since the demand for any one currency is tied to the demand for all other currencies by investors' desire to diversify risk, changes in the demand for one currency and, hence, its exchange rate, will affect the demand for and exchange rate of all other currencies." (p. 517). However, there are very few empirical studies along these lines in the literature.

3.4.2 Empirical evidence

Several studies have found statistical evidence of currency substitutability in Canada, namely Miles (1978), Brillembourg and Schadler (1979), Arango and Nadiri (1981), Alexander (1981), Poloz (1982) and Daniel and Fried (1983) . However, Giddy and Schadler (1980), Bordo and Choudhri (1982), and Cuddington (1983) found no such evidence. Although these results seem contradictory, Alexander and Poloz both emphasized that the estimated elasticity of substitution is quite small.

All studies, except that of Brillembourg and Schadler, were based on demand for money specifications. Miles used a different approach (which

is called "effective" by Boyer and Kingston (1981)), and his test has been criticized in many papers. In particular, Bordo and Choudhri noted an omitted variable problem. They repeated Miles' test with additional variables suggested by money-demand theory and found no evidence of currency substitution. In the other studies, the CS hypothesis was tested 'directly' by examining the significance of the forward premium (and sometimes other variables) in the demand for money equation. The statistical results obtained in this context differ from one study to another (probably because different data or different money-demand specifications were used — a particular example would be the inclusion of an adjustment for postal strikes), but for the most part, the estimated coefficients suggest that for policy purposes, currency substitutability can be ignored.

3.5 Conclusions

In models where unemployment can occur because wages and possibly prices are sticky in the short run, an increase in the degree of capital substitutability will increase the short-run impact of monetary policy on output. Indeed, since the empirical evidence, as presented in Chapter 2, indicates that the substitutability between domestic and foreign short-term capital is very high and the evidence presented in this chapter indicates that currency substitution is not important, the channels through which monetary policy affects the economy in the short run will depend heavily upon the stickiness of wages and prices, and possibly other aspects of behaviour in labour and product markets. By contrast, except for the very short run, perfect asset substitutability over time decreases the effectiveness of official exchange market intervention as a viable policy instrument. Thus, essentially, the monetary authorities have but one instrument to devote to achieving longer-run macroeconomic goals.

The empirical evidence presented on the behaviour of real interest rates and real exchange rates is consistent with the existence of significant wage and price stickiness, which may reflect the existence of

actual or implicit contracts and/or adaptive inflationary expectations. This suggests that through their short-run influence on nominal interest rates, the monetary authorities can influence real interest rates, and nominal and real exchange rates. Thus monetary policy in the short run likely affects aggregate demand through both the real interest rate and real exchange rate channels.[16] Since we have deferred until Chapter 4 a discussion of the effects of monetary policy on long-term interest rates, we will leave a discussion of the sectoral impact of policy until then.

Whether the short-run response of real interest rates to monetary policy reflects an extended Mundell-Fleming-type world or a new-classical-rational-expectations view of the world is beyond the scope of this study. The crucial empirical question may be how long it takes for the economy to approach classical-type equilibria, in which a given change in the money stock has a neutral effect on real variables regardless of the degree of capital substitutability.

Fiscal policy also can be expected to have an impact on the level of output in the short run as long as the expected exchange rate can differ from the current exchange rate, even in the presence of perfect substitutability of financial assets.

The finding that monetary (and fiscal) policy can affect output in the short run does not necessarily favour short-run activism, for two reasons. First, there is a presumption that the larger the change in the demand for real output, the larger the change in prices. This is clear in models where aggregate supply depends on unexpected price changes and the real exchange rate. It is also clear in Keynesian models with a Phillips curve relationship linking output (via its effect on unemployment) to wages and prices and with import prices affecting domestic wages and prices. More important than this initial effect on prices, however, is the recognition that if behaviour can be represented by an accelerationist model (that is, a model containing an inflation-augmented Phillips curve),

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16. In simulations with RDX2, Freedman and Longworth (1975) showed that after the first year or two, monetary policy had its greatest impact on the economy via the exchange rate, as opposed to the interest rate, channel.

the effects of monetary policy on output will be transitory, whereas the effect on the price level or the rate of inflation will be permanent. Second, any recommended policy must be affected by the degree of uncertainty about the economic structure. This uncertainty may manifest itself not only in stochastic error terms in structural equations, but in uncertainty about exclusion restrictions (especially on non-linear variables) in those equations, in uncertainty about the size of the relevant parameters (Brainard's multiplier uncertainty), and in uncertainty about the 'true' model of the economy (Mundell-Fleming, classical, new-classical, etc.).

These sources of uncertainty will, in particular, lead to uncertainty about the lags in the transmission of monetary policy (see, for example, Friedman (1961, 1953)). In such circumstances, the appropriate role of monetary policy may be to provide a nominal anchor to the system. This would favour orienting monetary policy towards achieving a satisfactory degree of price stability in the longer run, without major departures to cope with the short-run variance in the level of output.

CHAPTER 4

LONG-TERM BONDS AND MONETARY POLICY

4.1 Introduction

The focus of this chapter is the substitutability of Canadian and U.S. long-term financial assets and the associated implications for monetary policy. We are interested in whether domestic fiscal or monetary policy can exert an independent effect on real Canadian long-term interest rates. Specifically, we are interested in whether policy in Canada can induce a change of significant size or duration in the rate of return on Canadian bonds relative to the exchange-rate-adjusted rate on U.S. bonds.

How we test for the degree of substitutability depends on the underlying model used. With a simple portfolio model, we have to determine whether relative asset-stock variables have a significant effect in long-term interest rate equations, or alternatively, whether interest rate differentials play a role in asset-stock equations. If significant effects are found, then we can reject the hypothesis of perfect substitutability. However, when the model is expanded to include groups of agents with differing perceptions and a menu of assets where risk depends on variables other than the currency of denomination, the appropriate test is less clear. In this expanded model, it is quite possible that some Canadian and U.S. long-term assets will not be treated as perfect substitutes even though rate-of-return differentials do not depend on relative asset stocks.

This chapter is organized as follows. In Section 4.2 we look at the evidence from the market for Canadian long-term bonds. The preponderance of work in this area has used interest rates as the dependent variable, both because of the difficulty in collecting bond stock data and an econometric problem discussed below. In general, if the maintained hypothesis is that the degree of substitutability is very high, it is preferable to use rates as dependent variables; if a low degree of substitutability is the maintained hypothesis, then specifications using

asset stocks as dependent variables may be more appropriate. We will survey evidence from both types of equations. In looking at interest rate equations we will be interested in three types of effect: term structure effects (i.e., the impact of short-term interest rates through the term structure); foreign rate effects (i.e., the effect of U.S. short- and long-term interest rates on Canadian long-term rates); and finally, the presence of significant asset-stock variables in the equations.

Following a discussion of alternative theoretical models, we examine the empirical work on interest and exchange rate expectations. We begin by considering evidence presented by Freedman (1979b) on the term structure of bond rates and evidence on the uncovered-interest-parity hypothesis at long maturities which extends the work of Longworth et al. (1983).

Following this, we examine the estimated equations for long-term bond yields found in various Canadian econometric models. When comparing these estimates we will attempt to account for differences generated from the data used, data frequency and estimation periods. We continue by presenting our own monthly estimates of Canadian interest rate equations (for 1,2,3,5,10 and 20 years) which include recent data on yields for constant maturity bonds. These equations allow us to test directly and systematically for the effects discussed above over the full range of the term structure. In the final part of Section 4.2, we will look at previous work on bond market equations where the stock of bonds is the dependent variable.

In Section 4.3, we turn to portfolio capital flows in the balance of payments, and to the issue of political risk. We begin by reviewing some earlier studies in this area and proceed to look at the equations included in various Canadian econometric models. In dealing with the issue of political risk we will examine evidence on U.S.-dollar-denominated Government of Canada bonds issued in the United States.

Section 4.4 provides a summary of the results presented in Chapter 4 and discusses the implications for monetary policy.

4.2 The Long-Term Bond Market

4.2.1 Overview

In this section we discuss the theory and evidence pertaining to capital substitutability in the long-term bond market. We begin by outlining three approaches to modelling activity in this market: (i) portfolio balance with imperfect substitutability; (ii) uncovered interest parity; and (iii) the 'international term structure' approach recently developed by Beenstock and Longbottom (1981). Using these models as a basis for organizing our discussion of the evidence, we consider in turn results from Canadian econometric models and our own updated estimates using an improved data set. Following this, we look at some empirical work on equations that are normalized on the stock of bonds rather than on the interest rate.

4.2.2 Theory

Starting with the most general model, we can write the asset demand equation in the following way:

$$\frac{B}{W} = b(i - i^* - \Delta s^e) \qquad (1)$$

where

B = the bond stock,
W = wealth,
i = the interest rate,
s = the log of the exchange rate,
e = expectations
* = foreign variables,
Δ = first difference, and
b = a parameter

The term $i - i^* - \Delta s^e$ is the uncovered yield differential between foreign and domestic bonds. We can re-normalize this equation to determine the interest rate:

$$i = i^* + \Delta s^e + \frac{1}{b}\frac{B}{W} \qquad (2)$$

We are now able to discuss our three models as special cases of this general model.

If domestic and foreign assets are imperfect substitutes, then we have the general portfolio model discussed in Chapter 2. In models of this type, the demand for any asset depends on its own return and risk as well as the returns and risks of all other assets. The wealth constraint insures that all other assets are potentially important rather than only those assets that are close substitutes. The risk attached to any given asset depends on the covariance between its own return and the return on the rest of the portfolio. It is through their effect on the variance of the entire portfolio that relative stocks (which act as weights in summing the individual asset returns) assume their importance. In portfolio-balance models normalized on the interest rate, imperfect substitutability implies a significant role for relative stock variables. Equation (2) illustrates the special case of this model where a domestic bond and a foreign bond are the only two assets.

In the above analysis, we have discussed a demand-based portfolio model. It is equally valid to construct the portfolio from the borrowers' side, in which case we would write a series of bond-supply equations.

Consider next a special case of the uncovered-interest-parity model. Here, we assume that foreign and domestic bonds are perfect substitutes in the minds of investors and that Δs^e is constant. In this case, the stock variable does not appear in equation (2) since investors are unconcerned about the relative proportions of domestic and foreign bonds in their portfolios.

In developing the international term structure approach, Beenstock and Longbottom assumed uncovered interest parity so that foreign and domestic assets were perfect substitutes. The innovation in their approach involves the use of short-term interest differentials to model the expected change in the exchange rate. If uncovered interest parity holds at every point in the future, then future interest differentials

will reflect expected future exchange rate changes. If the future values of these two variables can be proxied by their own distributed lags, then we can replace unobservable exchange rate expectations with distributed lags of short-term interest differentials. As an example of this approach, Beenstock and Longbottom argue that the U.K. term structure in the 1970s, which was on average more steeply sloped than that in the United States, implied a greater expected rate of depreciation of sterling in the long run than in the short run. This argument is based on the idea that larger expected future interest differentials compensate international investors for the greater future rate of depreciation of the domestic currency. In this model, the effect of changes in comparable foreign rates on domestic rates is unity and the coefficients on the domestic and foreign short-term interest rates are equal but of opposite sign.[1] In terms of equation (2), we replace Δs^e with distributed lags of the short-term interest differential and expect that b will again be infinite so that 1/b is zero.

There are two other general points to consider. First, empirical differences between the values for the short- and long-run coefficients are likely to be important to policy considerations. Second, we must be aware of the difference between estimating bond market equations normalized on the asset stock and the interest rate. This is analogous to a question concerning exchange rate equations considered in Chapter 2 and considered in detail in Appendix B.

4.2.3 Bond rate and exchange rate expectations

In theoretical discussions of perfect substitutability such as the above, we usually assume that the expectations theory determines the term structure of interest rates and that uncovered interest parity holds.

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1. These are Beenstock and Longbottom's priors about these coefficients, although in fairness, we note that their model is designed to explain the term structure rather than the level of long-term interest rates. The assumption that term structures are the same in both countries is crucial to their expected short-rate coefficients. Without identical term structures, this result will not hold generally.

Tests of the validity of these assumptions are usually carried out as joint tests of the assumed model and market efficiency. In this section we review evidence from Freedman (1979b) on a joint test of the expectations theory of the term structure and rational expectations. Further, we present our own results, extending the work of Longworth et al. (1983), and the equations estimated in Chapter 2 which test uncovered interest parity and rational expectations jointly. [2]

Freedman used monthly and quarterly data from 1960 to 1978 to test his joint hypothesis. He matched an industrial long-term bond rate with short-term finance company paper in one set of estimates and a long-term government bond with a short-term treasury bill rate in another set. The coefficient on the lagged term-structure variable is consistently negative in all regressions explaining the change in the long-term rate, indicating that expected holding-period yields for short- and long-term bonds were not equalized over the sample period. On the basis of this evidence, Freedman was led to reject the joint hypothesis that combines the expectations theory of the term structure with rational expectations for the Canadian long-term bond market. [3]

One of the findings of Longworth et al. was that over short horizons, for example 30 days, the coefficient on the forward premium was negative in equations predicting the change in the spot exchange rate. In other words, on average over the 1970s, the forward premium erroneously predicted not just the magnitude but the direction of the movement in the spot rate over short horizons. When forward rates with longer maturities were used, for example 6 or 12 months, the coefficient became positive and closer to 1.0, its value under the joint hypothesis. We have extended this work to see how well the parity forward rate, that is the predicted

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2. The work of both Freedman (1979b) and Longworth et al. (1983) was designed to test the hypothesis of market efficiency. The efficiency tests are equivalent to a test of the joint hypothesis of rational expectations and a constant risk premium.

3. Pesando (1981) presents the empirical evidence that led him to conclude that the hypothesis of efficiency in the Canadian long-term bond market cannot be rejected. In particular, he illustrates the closeness of the martingale approximation for long-term government and corporate bond yields over the period 1957 to 1979. However, Freedman (1979b) has shown that, except in the special case where the yield curve is horizontal, the efficient markets hypothesis implies that the long-term interest rate does not follow a martingale process.

future spot rate implied by the uncovered-interest-parity condition, predicted the actual future spot rate over longer horizons.

In Table 7 we present estimates of three equations estimated for 1- , 3- , and 5-year maturities. Equation (1) relates the actual future change in the exchange rate to the expected change based on the uncovered-interest-parity condition. If the condition is satisfied then the expected change in the exchange rate over a given horizon is equal to the expected bond yield differential, and its coefficient in equation (1) will be unity. What happens in fact is that the estimated coefficient is significantly greater than 1.0 in the 1- and 3-year equations, but not in the 5-year equation.[4] This means that on average the direction of change for the spot rate was correctly predicted, but that for 1- and 3-year maturities at least, the magnitude of the change was underpredicted.

In equation (2), the variable to be predicted is the level of the future spot rate: the current spot and implied forward rates are used as predictors. When this regression was estimated by Longworth et al. using 30-day forward rates, the current spot rate was shown to be a superior predictor to the forward rate -- thus rejecting the joint hypothesis. The estimates for the 1- , 3- and 5-year equations in Table 7 also reject the joint hypothesis ($b = 1.0$, $c = 0.0$) for the 1- and 3-year horizons but not for the 5-year. In equation (3) we regress the level of the future spot rate on the predicted change, the current spot rate, and the purchasing-power-parity (PPP) variable used by Longworth et al. In accord with their results for short maturities, we find PPP to be a significant explanatory variable that was not fully incorporated in the uncovered-interest-parity prediction of the future spot rate.

In summary, the evidence presented here rejects the joint hypothesis of rational expectations and no risk premium for the long-term bond and exchange markets over long horizons. One possible interpretation of these results is that the formation of expectations in bond and exchange markets is not adequately captured by the rational expectations hypothesis. Although, strictly speaking, our results reject the joint hypothesis, the

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4. The standard errors have been adjusted for overlapping forecast periods using the technique developed by Hansen and Hodrick (1980).

Table 7

UNCOVERED INTEREST PARITY

Equation 1: $s_{t+k} - s_t = a+b\,(s^e_{t+k} - s_t)$

Period	a	b	S.E.E.
1 year	0.008 (0.003)	2.03 (0.25)	0.023
3 years	0.034 (0.005)	2.07 (0.23)	0.048
5 years	0.096 (0.008)	1.26 (0.24)	0.064

Equation 2: $s_{t+k} = a + bs^e_{t+k} + cs_t$

Period	a	b	c	S.E.E.
1 year	0.010 (0.004)	2.06 (0.26)	-1.09 (0.26)	0.032
3 years	0.041 (0.005)	2.24 (0.22)	-1.50 (0.25)	0.046
5 years	0.098 (0.008)	1.28 (0.24)	-0.76 (0.34)	0.063

Equation 3: $s_{t+k} = a + b(s^e_{t+k} - s_t) + cs_t + dppp$

Period	a	b	c	d	S.E.E.
1 year	-0.0134 (0.0040)	0.526 (0.26)	0.564 (0.054)	0.641 (0.074)	0.026
3 years	0.0108 (0.005)	0.668 (0.231)	0.191 (0.077)	1.02 (0.107)	0.034
5 years	0.065 (0.007)	-0.208 (0.219)	-0.556 (0.192)	1.35 (0.136)	0.042

Notes:

1. Lowercase letters denote logarithms.

2. $s^e_{t+k} = s_t \dfrac{(1 + i_t^k)^k}{(1 + i_t^{*k})^k}$

3. Sample periods are: 1-year 1971M1-1981M12
   3-year 1971M1-1979M12
   5-year 1971M1-1977M12

4. Standard errors (in parentheses) have been adjusted for overlapping forecast periods using the technique developed by Hansen and Hodrick (1980).

lack of significant stock variables in exchange rate and interest rate equations discussed elsewhere in the study (for example, the estimates presented in Section 4.2.5 and in Chapter 2) makes it doubtful that risk alone could be responsible for our findings. From the vantage point of hindsight, we can say that potential profits were unexploited, but whether the proper technique for discovering them was readily available at the time, and what the exact magnitude of these profits would have been, are two questions we have not addressed.

4.2.4 Evidence from Canadian econometric models

Much research on the behaviour of the bond market has been incorporated in econometric models of the Canadian economy. [5] A summary of the equations presented in seven models is given in Table 8.

The specification of these equations does not differ substantially from one model to another. The long-term Canadian interest rate is usually determined by lags on short-term Canadian interest rates (the 90-day paper rate or the 1- to 3-year Government of Canada bond rate) and by a U.S. long-term interest rate.

However, some models exhibit particular features worth noting. In the FOCUS model, long-term Canadian rates are generally explained by the four-quarter percentage change in the consumer price index rather than by a U.S. interest rate. The U.S. variable appears only in the equation for the municipal bond yield. [6] In the RDXF model, both short-term and long-term U.S. rates are included in the equation for the provincial bond yield (the representative rate in this model). Moreover, some models (CANDIDE, DRI, and TIM) include supply variables that have a significant effect on the long-term rate, although in the case of CANDIDE 2.0, only one of the three long-term equations includes a significant supply effect.

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5. The models considered here are those outlined in footnote 36 of Chapter 2 plus TIM, the model of Informetrica, and the world econometric model of EPA, the Japanese Economic Planning Agency.

6. Jump (1979) explains that U.S. rates will have an effect on Canadian long-term rates (through their effect on Canadian short-term rates) even though they do not appear directly in the equations.

In Table 8 we report the effects of an increase of 100 basis points in the U.S. long-term rate.[7,8] The impact of U.S. long-term rates on Canadian long-term rates is always inferior to one and in some cases is close to zero.[9] The long-run effect on the long-term (10 years and over) Government of Canada bond yield (which is the only rate appearing in every model) of a change of 100 basis points in the corresponding U.S. rate (which differs from one model to another) ranges from 23 (DRI) to 83 basis points (EPA). There is also some evidence (in RDXF) that the U.S. rate effect is smaller on Government of Canada bond yields with shorter maturities. Moreover, the U.S. rate seems to exert a greater impact on the provincial government and the industrial bond yields than on the Government of Canada bond yield (as evidenced in CANDIDE 2.0 and RDXF). Finally, there is no obvious link between the frequency of the data used and the size of the estimated impact of the U.S. rate.

Although stock variables do not appear in the majority of equations reviewed, their significant effect in some models provides evidence against the hypothesis of perfect capital substitutability. Clinton and Masson (1975) also presented estimates of monthly equations for the 5- to 10-year Government of Canada bond yields that showed a weak but significant asset-stock effect over the short run.

An important caveat here is that these results are affected when recent data, characterized by great interest rate variability and significant financial innovations, are included in the sample. This is discussed in the next section.

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7. The shocks performed correspond to a permanent increase in the long-term U.S. rate. The short-run effect is equal to the impact in the first period which can be the impact either in the first month, the first quarter or the first year, depending on the data frequency used in each model.

8. It is important to note that in calculating the effects of U.S. rates, the Canadian short-term interest rate is kept constant. In fact, this probably removes an important link between U.S. short rates and Canadian long rates -- namely through the Canadian short-term rate. If we had taken account of this channel of influence, the impact of the U.S. variables on the Canadian variables would have been higher.

9. One should note that an impact equal to one does not necessarily imply perfect substitutability.

Table 8

LONG-TERM BOND RATE EQUATIONS IN CANADIAN MACROECONOMETRIC MODELS*

Model	Data	Sample period	Equation	Effects of increase of 100 basis points in a U.S. rate			Supply variables	Other variables
				Increase of	Short run	Long run		
CANDIDE 2.0 (Oct. 1979)	Annual	1955-1976	ILF	ILIND*	56.4	56.4	Government of Canada bonds (except CSBs and TBILS)	IS
		1955-1975	ILP	ILIND*	61.9	61.9	Provincial and municipal securities held by Canadians	IS
		1955-1976	ILIND	ILIND*	71.3	71.3	-	IS
DRI [1] (Oct. 1983)	Quarterly	65Q1-82Q4	ILF	ILG*	22.9	22.9	Total government surplus (or deficit)/GNP	IMLF
EPA (August 1980)	Quarterly	65Q3-78Q1	ILF	ILIND*	76.4	81.9	-	IS, LDV
FOCUS (March 1980)	Quarterly	58Q2-76Q1	ILF	-	-	-	-	ISF, "
		58Q2-76Q1	IMLF	-	-	-	-	ISF, "
		58Q2-76Q1	IMSF	-	-	-	-	ISF, "
		58Q2-76Q1	ILP	-	-	-	-	ILIND, ILF
		58Q2-76Q1	ILM	IAAASL*	28.0	28.0	-	ILIND
		58Q2-76Q1	ILIND	-	-	-	-	ISF, "
MACE (August 1982)	Annual	1954-1980	ILF	IMSG*	25.4	52.3	-	ISF, LDV
RDXF (Sept. 1980)	Monthly	68M1-78M9	ILF	IAAAU*	43.1	76.4	-	ITB, ILP, LDV
		68M1-78M9	IMLF	IAAAU*	31.6	29.5	-	IMSF, ILF, LDV
		68M1-78M9	IMSF	IAAAU*	28.3	23.9	-	ISF, IMLF, LDV
		68M1-78M9	ILP	IAAAU*	49.9	83.9	-	IS, IS*, LDV
		68M1-78M9	ILIND	IAAAU*	37.6	86.5	-	ISF, LDV

Table 8 (cont'd)

Model	Data	Sample period	Equation	Effects of increase of 100 basis points in a U.S. rate			Supply variables	Other variables
				Increase of	Short run	Long run		
TIM (October 1983)	Annual	1956-1975	ILF	ILT*	21.9	41.0	Federal Government financial requirements from the public/money supply (M2)	IS, LDV
		1954-1975	ILIND	ILT*	21.9	41.0	Federal Government financial requirements/business cash requirements, federal Government debt to the public/money supply (M2)	ILF(coef.=1), (ILIND-ILF)t-1

* The variables are defined as follows:

ILF = Government of Canada bond yield, 10 years and over
IMLF = Government of Canada bond yield, 5-10 years
IMSF = Government of Canada bond yield, 3-5 years
ISF = Government of Canada bond yield, 1-3 years
ILP = Average yield for 10 provincial
ILIND = Average yield for 10 industrial
ILM = Average yield for 10 municipal
IS = 90-day paper rate
ITB = 90-day treasury bill rate
ILIND* = U.S. - industrial bond rate
ILG* = U.S. - yield on 20-year Government bonds
IAAASL* = U.S. - yield on AAA state & local government bonds
IMSG* = U.S. - average yield on 3- to 5-year government bonds
IAAAU* = U.S. - rate on recently offered AAA utility bonds
ILT* = U.S. - total bond rate
IS* = U.S. - 90-day paper rate
π = 4-quarter percentage change in the CPI
LDV = lagged dependent variable

1. Information concerning other long-term bond equations in this model was not available.

4.2.5 Estimates of bond rate equations using recent data

In order to test the theories outlined in Section 4.2.2 in a systematic way, as well as to take advantage of the most recent data available, we estimated a number of bond rate equations ourselves. One of the problems encountered in most empirical bond market studies is that yields are only available as weighted averages of yields on bonds of different maturities. In most cases, the weights and even the average term to maturity within a given maturity class (e.g., 3- to 5-year bonds) are not known to the researcher. Weight shifts within a maturity class may cause the rate for the class of bond to change even though the yield to maturity for all individual bonds remains constant through time. In order to avoid this problem, we used hypothetical yields of 1- , 2- , 3- , 5- , 10- and 20-year constant maturity U.S. government and Government of Canada bonds drawn from Bank of Canada and U.S. Treasury sources.[10] All data are described in detail in Appendix D.

To test the three theories outlined in Section 4.2.2, we specified a general equation from the portfolio model with local preference discussed in Section 2.4.3. The equation was estimated for each of the six maturities between 1 and 20 years using monthly data over the 1971M5 to 1982M12 period:

$$i_l = a_o + \sum_{j=o}^{3} b_j\, i^*_{l,t-j} + \sum_{j=o}^{3} c_j\, i_{s,t-j} + \sum_{j=o}^{3} d_j\, i^*_{s,t-j}$$

$$+ \sum_{j=o}^{3} e_j \left[\frac{B}{W+SW^*}\right]_{t-j} + \sum_{j=o}^{3} f_j \left[\frac{W}{W+SW^*}\right]_{t-j} + \sum_{j=1}^{3} g_j\, i_{l,t-j} \qquad (3)$$

where i_l = medium- or long-term interest rate (maturities of 1,2,3,5,10 and 20 years),
i_s = 90-day treasury bill rate,
* = foreign variable,
B = the stock of outside assets,
W = the stock of outside assets plus cumulated bilateral current account (wealth), and
S = the price of foreign exchange.

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10. The yields on these 'fictional' bonds are taken from hypothetical curves constructed by the Bank of Canada and the U.S. Treasury.

Rational lag structures were used and insignificant variables were eliminated. We used the constant maturity data for our long-term bond rate variables, 90-day treasury bill yields as our short-term rates,[11] and relative stocks of outside assets (expressed in Canadian dollars) as our stock variables. Inclusion of the monetary base in the relative stocks made no substantial difference to the results. The wealth variables include the relevant stock of outside assets as well as the bilateral cumulated current account. The estimates of the equations are given in Table 9.

The estimates presented in Table 9 generally display long-run coefficients on U.S. rates of comparable maturity that are high relative to those usually found in the econometric models surveyed in Section 4.2.3. The coefficients on domestic and foreign short-term rates are of roughly equal magnitude but of opposite sign. The relative stock variable is never both significant and correctly signed, while the relative wealth variable is significant and correctly signed for only the 1- and 20-year maturities.

The absence of significant relative stock variables implies that we cannot reject the hypothesis of perfect substitutability.[12] An F-test was used to test the restriction b = 1 (the long-run coefficient on the comparable maturity U.S. rate is 1), consistent with both the uncovered interest parity and international term structure approaches (column F_1). We rejected the restriction for the 1- , 3- and 5-year equations. The restriction that c = -d (the long-run coefficients on Canadian and U.S. short-term rates are of equal magnitude but opposite sign) was also similarly tested (column F_2). This restriction was rejected at the 5 per cent level for the 1- , 3- , 5- and 10-year equations. The rejection of this restriction for a majority of the equations casts doubt on the role of the short-term interest differential

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11. Government treasury bill rates were used in order to make short- and long-term instruments more comparable with respect to the risk attributable to the issuer.

12. The absence of lagged stock variables rules out cases where substitutability is imperfect in the short run, but perfect in the long run. This is relevant for the conclusions we draw in Section 4.4.

as a proxy for expected exchange rate changes -- one of the important motivations of the international term structure theory.

Overall, the results presented in Table 9 provide little unambiguous support for any of the models tested; it may be that none of the models adequately captures all of the factors that determine medium- and long-term interest rates. The international term structure approach is not rejected by the data, although there is little evidence as to whether short-term interest rates are acting as proxies for exchange rate expectations or whether they represent some other factor. In an effort to investigate this question further, we replaced short-term interest rates with an expected exchange rate depreciation term based on current and lagged exchange rates and purchasing-power parity. The expectations term was constantly updated using a rolling regression technique. If the two types of expectations proxies were interchangeable in the equation, then this would confirm the exchange rate expectations role ascribed to the short rates by the international term structure approach. Unfortunately, the PPP expectations term was generally insignificant so we were unable to confirm the role of short-term rates as proxies for the expected rate of exchange rate depreciation.

In summary, whereas the popular models generally have relatively low coefficients on U.S. rates and sometimes include significant stock variables, our own estimates using more recent data are more favourable to the hypothesis of perfect substitutability.[13] We reject the portfolio model with imperfect substitutability because of insignificant stock variables, but find only tentative support for the international term structure approach.

4.2.6 Bond stock equations

Several authors, notably Dobson (1973) and Christofides (1975) have estimated reduced-form equations that included stocks among the explana-

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13. Further work could be done to test for the presence of structural change in these equations. It would also be interesting to see if the results were affected by a change in the specification of the debt-stock variables.

Table 9

COEFFICIENTS OF UPDATED CANADIAN BOND RATE EQUATIONS: 1971M5 to 1982M12

Equation 3:

$$i_1 = a_0 + \sum_{j=0}^{3} b_j\, i^*_{1,t-j} + \sum_{j=0}^{3} c_j\, i_{m,t-j} + \sum_{j=0}^{3} d_j\, i^*_{m,t-j}$$

$$+ \sum_{j=0}^{3} e_j \left[\frac{B}{M_0 SM^*}\right]_{t-j} + \sum_{j=0}^{3} f_j \left[\frac{W}{M_0 SM^*}\right]_{t-j} + \sum_{j=1}^{3} g_j\, i_{1,t-j}$$

Maturity		a	b	c	d	e	f	g	S.E.E	F_1	F_2
1-year	impact	0.785	0.594	0.615	-0.200	1.43	-7.70	0.916	0.226	4.87	4.83
	t-value	(2.22)	(10.39)	(11.63)	(4.11)	(.53)	(3.02)	(11.32)			
	long run		0.731	0.720	-0.471	3.36	-18.11				
	lags included		2	4	0	0	0	2			
2-year	impact	0.621	0.730	0.379	-0.156	2.86	-7.50	0.913	0.269	1.08	0.93
	t-value	(.60)	(8.95)	(4.51)	(2.07)	(.43)	(1.02)	(7.27)			
	long run		0.832	0.526	-0.379	6.96	-18.25				
	lags included		2	2	0	0	0	2			
3-year	impact	0.894	0.670	0.276	-0.059	-3.52	-4.766	1.02	0.246	5.60	5.93
	t-value	(2.09)	(12.49)	(5.14)	(2.32)	(1.21)	(1.29)	(12.28)			
	long run		0.703	0.457	-0.197	-11.73	-2.55				
	lags included		2	2	0	0	0	2			
5-year	impact	1.17	0.778	0.098	-0.032	-5.06	-0.752	0.883	0.236	6.99	8.14
	t-value	(2.96)	(15.86)	(4.77)	(1.73)	(1.86)	(.29)	(13.79)			
	long run		0.691	0.383	-0.117	-19.77	-2.94				
	lags included		1	0	0	0	0	2			
10-year	impact	0.913	0.856	0.061	-0.031	-2.18	-3.05	0.888	0.201	2.60	4.80
	t-value	(2.69)	(17.90)	(4.00)	(2.02)	(.94)	(1.42)	(13.09)			
	long run		0.833	0.248	-0.126	-8.86	12.40				
	lags included		1	0	0	0	0	2			
20-year	impact	0.749	0.781	0.158	-0.070	1.56	-5.64	0.691	0.213	0.84	1.59
	t-value	(2.09)	(14.27)	(3.93)	(3.61)	(.64)	(2.51)	(11.81)			
	long run		0.919	0.301	-0.226	5.05	18.25				
	lags included		2	1	0	0	0	1			

Note: F_1 tests hypothesis b = 1.0 in the long run; F_2 tests hypothesis c-d = 0 in the long run. Critical F = 4.00 at α = .01.

tory variables, although in both cases the estimated stock effects are small. Masson (1978) presents a structural model of the demand for bonds estimated using monthly data over the 1968-74 period. He distinguishes between demands originating from the public sector and those originating from the banking sector. For each group, equations are estimated for long-term bond holdings and short-term bond holdings. A reduced-form equation is derived for short-term and long-term bond yields with stock variables that have significant effects. The results of this study are thus supportive of the portfolio model with imperfect substitutability. Unfortunately, in later work at the Bank of Canada that extended the sample period to 1977, it was found that the coefficients of the stock demand specification were not robust.

4.3 Portfolio Capital Flows and Political Risk

4.3.1 Overview

In the first part of this section, we are concerned with evidence from the empirical modelling of portfolio capital flows. We begin with a brief discussion of how these equations can be derived from a portfolio-balance approach. Thereafter, we present an overview of the main features of the equations estimated in Canadian macroeconometric models.

In considering the issue of political risk (the second part of the section), we will confine ourselves to looking at the premium paid on sovereign debt denominated in foreign currency so that exchange risk is not a factor. Our evidence on this is drawn from recent work by Lessard et al. (1983).

4.3.2 Evidence from portfolio capital flows equations

4.3.2 (a) Some theoretical considerations

The long-term capital flow equations estimated in Canadian macroeconometric models are based on the assumption of imperfect substitutability between long-term domestic and foreign assets. The

borrowing decisions are assumed to depend on the expected relative borrowing costs (represented by interest rate differentials, sometimes adjusted for the expected rate of change of the exchange rate) and the relative risks, while the lending decisions are assumed to depend on the expected relative yields and the relative risks.

Originally, the portfolio model is specified in the following way:

$$\frac{B}{W} = \alpha(i-i^*) \qquad 4(a)$$

or

$$B = \alpha(i-i^*)W \qquad 4(b)$$

where B = the stock of an asset in the portfolio,
W = wealth,
i = the nominal interest rate, and
$*$ = a foreign variable.

There are two ways one can derive equations with a flow variable on the left-hand side from equations 4(a) and 4(b). First, it is possible to estimate the model in first-difference form to obtain:

$$\Delta B = F = \alpha(i-i^*)\ \Delta W + \alpha\Delta(i-i^*)W \qquad (5)$$

where Δ represents the first difference, and
F is a flow.

Alternatively, one can assume that equations 4(a) and 4(b) hold only in equilibrium and that there is a lagged adjustment of the actual to the desired stock (B^d):

$$B^d = \alpha(i-i^*)W \quad \text{and} \qquad (6)$$

$$\Delta B = F = \lambda(B^d - B_{-1}) \qquad (7)$$

By substituting equation (6) in equation (7), we obtain

$$F = \lambda(\alpha(i-i^*)W) - \lambda B_{-1} \qquad (8)$$

The type of specification shown in equation (8) appears in the models that are reviewed below (it is assumed that the flows measured in the balance of payments statistics are equal to the change in stocks). Alternatively, this equation could have been derived from the borrowers' side instead of the lenders' -- in which case, B and W would have been replaced by the debt denominated in a given currency and the total debt outstanding, respectively.

4.3.2 (b) Empirical evidence

Capital flows in the balance of payments can be disaggregated in a number of ways, and this leads to a great diversity of estimated equations, as is evident in Tables 10(a), 10(b) and 10(c). The more disaggregated the flows, the more confidence we have in the results. In considering portfolio capital flows as a whole we were confronted with a number of problems, such as the aggregation of two assets that have fundamentally different types of returns (i.e., bonds versus equity), or the aggregation of assets with different asset-specific risks (i.e., government and corporate bonds). Moreover, there are a certain number of Canadian bonds sold abroad that are denominated in Canadian dollars so there is a currency mix in the dependent variable. We first look briefly at three major studies of capital flows in Canada, and then examine the models in current use.

Freedman (1970) examined the case of U.S.-pay Canadian bonds in some detail. He estimated a quarterly model using ordinary least squares and a simultaneous equation technique over the 1954 to 1966 period. Separate equations were estimated for the supply and demand for these bonds.[14] The interest rate differentials were generally significant over the whole

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14. It is assumed that Canadians do not hold this type of bond.

period, but not for some exchange rate subperiods. Caves and Reuber (1971) estimated equations for the net inflows of portfolio capital depending on long-term Canadian and U.S. interest rates (included separately), the difference between the long-term and short-term Canadian interest rate, and a financial requirements variable. Their results also showed a significant impact of interest rates on capital flows.

Johnson (1983) expanded the work done by Freedman. He examined the link between the share of the debt outstanding (value of Canadian dollar bonds outstanding/value of total bonds outstanding) and a proxy for the ex ante real interest rate differential between Canadian-dollar-denominated bonds and U.S.-dollar-denominated bonds.[15] His results indicated that during the 1962-1979 period, the corporate sector and particularly the financial corporate sector, responded significantly to the difference between the exchange-rate-adjusted cost of borrowing while the provincial sector did not respond.

We will now examine the results from the macro models currently in use: CANDIDE 2.0, FOCUS, MTFM, RDXF, EPA, MACE, and TIM. In Table 10 we divide the capital flows equations into three categories: Table 10(a) deals with new issues of bonds sold abroad; Table 10(b) deals with the trade in outstanding Canadian bonds; and finally, Table 10(c) presents other equations found in the models that explain more aggregated flows. It is usually assumed that the decision concerning new issues of bonds will be dominated by the borrowers' behaviour but that the trade in outstanding bonds will reflect primarily the lenders' behaviour.

The long-term Canadian-U.S. interest rate differential appears in almost all the equations (the exceptions are: MACE, the equation for foreign securities in CANDIDE, and the equation for trade in outstanding

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15. The equations are estimated for the fixed (1962Q2-1970Q1) and flexible (1970Q2-1979Q1) exchange rate subperiods. For the fixed rate period, it is assumed that people do not expect a change in the exchange rate. For the flexible period, the expected depreciation is proxied by the actual annual average rate of depreciation over the next three years after the period under study. The equations are estimated with non-linear limited information maximum likelihood techniques, allowing within-equation restrictions.

Table 10 (a)

EQUATIONS FOR 'NET NEW ISSUES OF BONDS ABROAD'

Model	Dependent variable	Sample period	Long-term interest rate differential	Financial requirements	Stock adjustment	Other variables
CANDIDE 2.0 (Oct. 1979)	Federal bond issues abroad	1959-1975	Federal government bond rate minus U.S. total bond rate (est. coef. = 101.89) [1]	Change in federal Government deficit	-	Actual minus expected exchange rate, U.S. investment requirements relative to the availability of funds, dummies
CANDIDE 2.0 (Oct. 1979)	Net provincial and municipal bond issues abroad	1959-1975	Provincial bond rate minus U.S. total bond rate (est. coef. = 940.81)	Change in outstanding stock of provincial and municipal debt, pension fund surpluses available to these governments	-	U.S. investment requirements relative to the availability of funds, dummy
CANDIDE 2.0 (Oct. 1979)	Net new issues of corporate bonds abroad	1959-1975	Industrial bond rate minus U.S. industrial bond rate, distributed lag (Σ est. coef. = 341.11)	Change in (private inventories minus CCA minus retained profits)	-	Dummies
FOCUS (March 1980)	Net new foreign issues of provincial and municipal bonds	1960Q1 - 1977Q2	(Municipal and provincial bond rate minus U.S. state and local bond rate)* (4-quarter moving average of non-federal Government expenditures), distributed lag. On average over the sample period, a change of 1 percentage point in the differential will shift new issues by $575 million (mean of the series = $1051 million).	Net deficit provincial, municipal, and hospitals, plus net surplus of Canada and Quebec pension plans	Stock of provincial and municipal bonds outstanding/U.S. stock of state and local bonds outstanding (t-1)	Dummies

1. The estimated coefficients are comparable among equations. They represent the change in 'new issues' in millions of dollars following a change of 1 percentage point in the interest rate differential.

Table 10 (a) (cont'd)

EQUATIONS FOR 'NET NEW ISSUES OF BONDS ABROAD'

Model	Dependent variable	Sample period	Long-term interest rate differential	Financial requirements	Stock adjustment	Other variables
FOCUS (March 1980)	Net foreign issues of corporate bonds	1962Q1 - 1977Q2	(Industrial bond rate minus U.S. industrial bond rate)*(4-quarter moving average of private GNP), distributed lag. On average, over the sample period, a change of 1 percentage point in the differential will shift new issues by $225 million (mean of the series = $761 million).	-	-	Dummies
MTFM (Oct. 1983)	Net new provincial and municipal bond issues abroad (scaled by the financial requirement variable)	1968Q1 - 1978Q4	Change in (provincial bond rate minus U.S. rate), 7-quarter moving average	Government spending on goods and services (provincial and municipal)	-	Dummies
MTFM (Oct. 1983)	Net new corporate bond issues abroad (scaled by the financial requirement variable)	1968Q1 - 1978Q4	Change in (industrial bond rate minus U.S. rate), 7-quarter moving average	Business investment	-	Retained corporate earnings (t-1)/ business investment, dummy
RDXF (Sept. 1983)	Net new issues of all bonds sold abroad (scaled by the financial requirement variable (placed on RHS))	1971Q1 - 1981Q4	Provincial bond rate minus U.S. AAA utilities rate. A change of 1 percentage point in the differential would have led to $3.3 billion (annual rate) more foreign issues in 1982.	Financial requirements of junior levels of government and business sector	Stock of Canadian bonds held by non-residents/U.S. nominal GNP(t-1)	90-day commercial paper rate minus U.S. paper rate, proxy for recycling of OPEC revenues, provincial and municipal government investment on goods and services, dummies

Table 10 (b)

EQUATIONS FOR 'NET TRADE IN OUTSTANDING BONDS'

Model	Dependent variable	Sample period	Long-term interest rate differential	Stock adjustment	Other variables
CANDIDE 2.0 (Oct. 1979)	Net trade in Canadian corporate bonds	1959 - 1975	(Industrial bond rate minus U.S. industrial bond rate)* (actual minus expected exchange rate), distributed lag (Σ est. coef.=1172.47)	Stock of long-term corporate securities held by non-residents, distributed lag	Distributed lag on the change in (non-residential construction and machinery and equipment inventory minus CCA minus undistributed corporate profits), dummies
FOCUS (March 1980)	Changes in outstanding bonds and stocks	1961Q1 - 1977Q4	(3-5 year federal Government bond rate minus U.S. 3-5 year bond rate)$_{a}$(4-quarter moving average of Canadian and U.S. nominal GNP), distributed lag	-	Distributed lag on the change in [(90-day paper rate minus 90-day Eurodollar rate)*(4-quarter moving average of Canadian and U.S. nominal GNP)], growth differential Canadian and U.S. GNP, dummies
MTFM (Oct. 1983)	Net trade in outstanding Canadian bonds	1968Q1 - 1978Q4	-	-	Distributed lag on the 3-quarter moving average of the Canadian-U.S. treasury bill rate differ-, ential, U.S. GNP (in $Can.), dummies
RDXF (Sept. 1983)	Trade in outstanding bonds	1971Q1 - 1981Q4	Federal Government bond rate (10 yrs +) minus U.S. government bond rate (10 yrs +) (t and t-1) (est. coef. at t=67.20, t-1=128.68)	Cumulated stock of net new issues held by non-residents plus net trade in outstanding/U.S. household financial assets	Proxy for recycling of OPEC revenues, difference in 8-period moving variance of Canadian/U.S. government bond rates (10 yrs +), Can/U.S. inflation rate differential (t-1), dummies

Table 10 (c)

OTHER EQUATIONS

Model	Dependent variable	Sample period	Long-term interest rate differential	Other variables
CANDIDE 2.0 (Oct. 1979)	Foreign securities	1959-1975	-	Change in (undistributed corporate profits plus capital stock, utilities plus government savings plus CCA), 90-day rate minus U.S. commercial paper rate, U.S. non-residential fixed investment and inventory change minus undistributed profits, dummies
EPA (August 1980)	Flow of long-term portfolio assets (scaled by net worth)	1965Q2 - 1978Q1	Government bond rate minus U.S. long-term corporate bond rate	Stock of portfolio assets/net worth (t-1), dummy
EPA (August 1980)	Flow of long-term portfolio liabilities (except federal Government borrowings)	1965Q3 - 1978Q1	Government bond rate minus U.S. long-term corporate bond rate (est. coef.=6952.3, 75Q4-76Q4 =1381.0, elsewhere)	Government deficit and business financing requirements, dummies
MACE (August 1982)	Net liabilities to non-residents (except business assets)/total OECD incomes(price of foreign exchange) $^{0.25}$	1954-1980	-	1-3 year federal Government bond rate minus 91-day U.S. Treasury bill rate, 'temporary' surplus or deficit in the current account, lagged dependent variable
TIM (Oct. 1983	Canadian portfolio investment in U.S. (scaled by gross financial wealth (placed on RHS))	1961-1975	Government bond rate - U.S. total bond rate minus percentage change in the exchange rate	Outstanding value of U.S. securities held in Canada/wealth (t-1), dummies
TIM (Oct. 1983)	Canadian portfolio investment in ROW (scaled by gross financial wealth (placed on RHS))	1961-1975	Government bond rate minus U.K. long-term government bond rate	Percentage change in (Can$/U.S.$ exchange rate*U.S.$/pound exchange rate) (t-1), dummies

bonds in MTFM).[16,17] The differential is sometimes included only contemporaneously, while in other instances, it is included in distributed lag form. However it is presented, the long-term rate differential always has a significant impact, except in the TIM model. In the MTFM model, it is the change in the interest rate differential instead of the level of the differential that is included in the equations for new issues of bonds. In the FOCUS model, the interest rate differential is multiplied by scale variables. There are two equations where the differential is adjusted for the exchange rate: one in CANDIDE and another in TIM. Moreover, in two equations -- the 'net new issues of all bonds' in RDXF and the 'changes in outstanding bonds and stocks' in FOCUS -- the short-term interest rate differential is also included.

The 'new issues' equations are specified as a function of a financial requirements variable (in some cases, homogeneity is imposed). The results are mixed concerning the presence of a stock-adjustment term. The three equations of the CANDIDE model and the equations of the MTFM model do not include stock terms, while the equation for issues of provincial and municipal bonds in FOCUS and the RDXF equation include such a term. The CANDIDE model is the only one to provide an equation for federal bonds issued abroad. In the other models, these transactions are viewed as exogenous policy variables.

There are four equations dealing with trade in outstanding bonds; three of them are concerned with all types of bonds (FOCUS, MTFM and RDXF), while the other deals only with the corporate sector (CANDIDE). A stock-adjustment term appears in the RDXF and CANDIDE equations but not in FOCUS and MTFM. We note that the RDXF equation includes a term that is presumed to represent the expected relative variability in bond prices and therefore differences in interest rate risk.

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16. In SAM, the Bank of Canada's annual model, the foreign-pay bonds are assumed to be gross substitutes for domestic-pay bonds. A change in the interest rate differential will shift the level of net foreign liabilities but a permanent change in capital flows will not result. A 100-basis-point increase in favour of Canada (assuming no effects on the supply of foreign assets and no change in exchange rate expectations) will lead to a cumulated capital inflow equal to 9 per cent of net foreign assets. In a full-model simulation where the supply of net foreign assets is allowed to respond, the resulting cumulated inflow is doubled.

17. The detailed econometric results of the DRI model are not available, but the long-term interest rate differential is in the equations for new issues of corporate bonds and new issues of provincial and local bonds abroad in this model.

The CANDIDE, EPA and TIM models include equations for Canadian portfolio investment. In EPA and TIM, the long-run wealth elasticity is constrained to be unity and a stock-adjustment specification is employed. Nearly all equations include dummy variables to take account of several specific events.

4.3.2 (c) Implications

Significant stock and wealth variables are absent in a majority of the capital flow equations presented above, which is inconsistent with imperfect substitutability in the portfolio-balance framework. Yet, we observe a significant response of capital flows to the interest differential. This finding suggests that some agents do not act as if all foreign and domestic assets are perfect substitutes. However, this result may be due, in part, to aggregation over different types of bonds and non-homogeneous groups of agents.

4.3.3 Political risk

Defined in its usual sense, the term political or 'country' risk refers to the risk of non-performance on loans to sovereign borrowers. Non-performance, which usually means default or arrears, may be a consequence of economic events, e.g., balance of payments crises, and/or political action, e.g., repudiation or expropriation. In our discussion, we will confine ourselves to generalized country risk, that is risk attributable only to the country of issue and ignore other, potentially important, asset-specific types of risk.

Our discussion of this issue is based primarily on the work of Lessard et al. (1983). In Part 4 of their study, the authors attempt to quantify political risk for Canada by comparing the yields of similar Canadian and U.S. government bonds issued in New York. When these so-called 'Yankee' bonds issued by the Canadian government are compared, currency risks and tax and regulatory differences are eliminated, leaving only perceived country risk remaining.

Lessard et al. used two methods to examine the Canadian country risk premium. The first involved creating a time series of the 'at-issue' yield differential. Using eleven Canadian government and government-guaranteed bonds issued between 1978 and 1983, they found the average differential to be 63 basis points or 6.03 expressed as a percentage of the yield on the comparable U.S. government bond. Although this is an indication of a political risk premium for Canada vis-à-vis the United States, the small number of observations makes the authors hesitant to draw conclusions without further evidence.[18]

The second method was to construct time series by following the yields of three closely matched pairs of 'Yankee' (Canadian government U.S.-dollar-denominated bonds) and U.S. government bonds over time. The evidence from these data confirms the results obtained using the 'at-issue' data. The results for the medium- and long-term bonds comparison seems to indicate that 60 basis points is a reasonable estimate of the 'political' risk premium paid on Canadian government U.S.-dollar-denominated bonds above the rate on comparable bonds issued by the U.S. government.[19]

The evidence we have examined has been confined to issues placed in New York.[20] Ideally, we would also like to compare the yields of Canadian and U.S. government bonds issued on the Eurocurrency market. This would allow us to gauge the perception of the relative risks of these bonds in 'neutral' territory. Unfortunately, of the five least-risk sovereign borrowers (according to the ranking of Institutional Investor magazine), Canada (ranked fifth) is the only country to place issues on

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18. A possible bias stems from the fact that Export Development Corporation bonds dominate the most recent issues considered. It is generally believed that these bonds are priced lower than Government of Canada bonds since they are guaranteed rather than issued by the federal Government. Their dominance among recent issues may make the risk premium appear to be rising over time.

19. Although we have argued earlier in the chapter that the risk premium is not related to the proportion of foreign portfolios consisting of Government of Canada bonds, it is possible that government policy actions can influence the risk perceived by foreign investors.

20. Recent Euro-Canadian bonds have traded at yields below U.S. Treasury bond rates. This suggests that political risk is also sensitive to location of issue. In addition it seems likely that perceptions of political risk will differ across investors of different nationalities.

the Euromarket and thus a comparison such as that described above is not possible.

4.4 Conclusions

Throughout this chapter we focused on whether Canadian bond rates adjusted for exchange rate expectations could differ significantly from comparable U.S. rates. The weight of evidence seems to indicate that medium- and long-term Canadian and U.S. government bonds are fairly close substitutes in the long run. Our conclusion is based on the absence of significant stock variables in the majority of the interest rate equations -- a necessary condition for imperfect substitutability within the framework of the portfolio-balance model. Changes in U.S. medium- and long-term rates are found to give rise to approximately equal long-run movements in Canadian yields adjusted for exchange rate expectations.

In Section 4.3, significant stock and wealth variables are generally absent in the capital flows equations -- a finding that is inconsistent with the portfolio-balance model. However, the significant interest differential terms in these equations draw attention to both the possibility of short-run imperfect substitutability and the likelihood that some non-government bonds in the two countries are regarded as distinctly different assets by investors. This implies that expected yields on Canadian and U.S. bonds may move differently, at least in the short run. These findings may be a result of aggregation over different kinds of bonds that carry important asset-specific risks, or aggregation over agents who have widely differing perceptions and expectations.[21]

Some data on the extent to which Canadian interest rates have moved differently from U.S. rates may help to put this question into perspective. The variability of the interest differential between Canadian and U.S. government bonds becomes steadily smaller as the

21. A further possibility is that the sample periods used in estimating these equations, which encompassed significant domestic and international financial market innovation, did not permit estimation of the structure of financial markets as it currently stands.

maturity of the bonds lengthens.[22] The mean differential over the 1971-82 period ranged from 0.60 per cent for 3-year bonds to 1.22 per cent for 20-year bonds. The standard deviation of the differential was largest for treasury bills at 1.90 per cent and smallest for 10- and 20-year bonds at about 0.47 per cent. If we assume relatively constant expectations of long-run exchange rate changes over the period, this suggests that the scope for independent movement in the Canadian rate is less at the long end than at the short end, and also possibly that the effect can only be short-lived.

Even with perfect substitutability, the monetary authority could affect real long rates in the short run by changing short-term rates and causing the expected change in the exchange rate to differ from the expected inflation differential. Evidence of this is provided by the presence of significant short-term domestic rates in our medium- and long-term rate equations. This short-run influence of monetary policy on real long rates has consequences for the interest-sensitive components of aggregate demand such as consumer durables expenditures, housing, and investment. This effect provides an additional transmission mechanism for monetary policy that can be added to those discussed in Chapter 3. However, there are typically quite long lags in the influence of long-term interest rates on outlays, therefore a temporary change in rates cannot be expected to have a large effect on spending. In any case, the influence will be short-lived since, over the longer run, the expected rate of exchange rate change will conform to the expected inflation differential. The absence of stock variables in the interest rate equations means that authorities cannot rely on imperfect substitutability to permit them to influence real long rates over the longer term.

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22. Over the period 1971M1-1982M12, the differential was as follows:

Maturity	Mean differential	Standard deviation
90 days	1.08	1.90
1 year	0.64	1.17
3 years	0.60	0.74
5 years	0.61	0.60
10 years	0.77	0.46
20 years	1.22	0.47

CHAPTER 5
CAPITAL MOBILITY AND LONG-RUN FISCAL POLICY

5.1 Introduction

This chapter is designed to serve two purposes. The first is to complete the survey of the evidence on the elasticity of the financial components of the capital account with respect to rates of return. In Section 5.2, research on direct investment and national rates of return on real capital are surveyed. In Section 5.3 the focus is shifted from individual financial components to the transfer of real resources represented by the total net capital flow or, equivalently, to the current account balance. The research surveyed uses the identity between the current account balance and domestic savings minus investment as an organizing framework.

In the context of real capital, the distinction between mobility and substitutability has little meaning. If rates of return on real assets in Canada and abroad are not equalized, we have evidence of imperfections in the capital market, but it makes no difference whether we talk about imperfect substitutability or imperfect mobility. We can therefore use either term interchangeably in this chapter. Our major substantive conclusion here is that the perfect mobility (substitutability) hypothesis may be valid for real capital in Canada, although there is no strong empirical support for it.

Our second purpose is to discuss the long-run allocative implications for fiscal policy (Section 5.4). The degree of capital substitutability has an important bearing on the 'crowding out' debate and on the appropriate policy choices to stimulate domestic capital formation. It is widely accepted that in the long run, output is determined by supply conditions. If this is so, there would be very close to complete crowding out of the output effects of fiscal policy. The form in which crowding out will occur is greatly influenced by capital mobility -- the higher the degree of capital mobility, the lower the impact on domestic investment and the greater the impact on the trade balance. We also note some

implications for the social rate of discount. Section 5.5 contains the conclusions of the chapter.

5.2 Direct and Equity Capital and Rates of Return

5.2.1 Direct investment equations

In the Canadian balance of payments, direct investment is defined as a long-term capital movement that finances the establishment or growth of a controlled subsidiary, the acquisition of a controlling interest in a foreign concern, or the purchase of fixed assets abroad. Expansion of subsidiaries is counted as direct investment only to the extent that it is financed by equity or debt from parent companies. Expansion financed by retained earnings of subsidiaries is not included, in contrast to practice in the United States and some other countries.

This definition does not correspond to spending on real capital by foreign firms but rather to the financing of that spending. As such, it contains an element that behaves in a manner similar to the portfolio flows discussed in Chapter 4. We should note that research results on retained earnings of subsidiaries should not be neglected merely because the latter are ignored in the published balance of payments, because for some purposes it is important to take them into account (Clinton and Longworth (1982)). In fact, investment of retained earnings in Canada in the 1971-80 period was over four times the value of direct investment financed externally.

It is evident from the extreme variability of direct investment flows in recent years that certain special circumstances have frequently had a large impact. For many years prior to 1975 Canada was a net importer of direct investment. Since then, it has been an exporter, experiencing an average annual outflow of $2 1/2 billion, with a peak of over $11 billion in 1981. Most of the recent variance in flows has been due to enormous swings in takeover activity, which econometric models are not capable of explaining.

Recently published econometric work on the elasticity of Canadian direct investment flows with respect to relative rates of return is not extensive, but we can also draw on the reseach done on U.S. investment abroad, of which the flow into Canada is a large component. Choudry et al. (1968) found that rate of return differentials had no significant impact on net direct investment in Canada. Hufbauer (1975), in a survey of the evidence for U.S. direct investment abroad, came up with a similar negative conclusion. Some authors, however, found statistically significant rate of return variables with U.S. data (e.g., Prachowny (1972)).

There has been some success with adaptations of models originally developed to explain real capital accumulation. However, for the reasons noted above, these are not strictly applicable to the balance of payments definition of direct investment. In these models, expected returns enter the equations via an expected-value-of-output term rather than as separate explanatory variables, so it is difficult to distinguish the effects of expected returns from those of expected sales and market size. Caves and Reuber (1971) used an accelerator model but subsequently, the neoclassical model (Jorgenson (1963)), which has a more explicit role for rates of return, gained popularity. In the neoclassical model, rates of return are incorporated into a measure of the rental rate on capital. The empirical results from this model can be interpreted as showing an important influence of yields and costs on direct investment (e.g., Kwack (1972), Stevens (1972) and Goldsbrough (1979) for the United States). Hartman (1981) took account of tax provisions and was able to show a strong independent influence of relative rates of return on investment of retained earnings by U.S. subsidiaries abroad, but not on 'new' direct investment.

Murray (1982) used the neoclassical model to study the sensitivity to tax rates of U.S. direct investment in Canadian manufacturing. His data from the U.S. Department of Commerce cover a period ending in 1976 and include reinvested earnings of subsidiaries. The estimates show an elasticity of almost minus one for the opportunity cost of capital in the United States.

Direct investment flows have been found to be responsive to changes in the availability, as distinct from the cost, of finance in numerous studies (e.g., Caves and Reuber, Kwack).

Econometric research using portfolio or investment models as described above has been taken to task for neglecting the market imperfections that cause the very existence of direct investment (Kindleberger (1969)). These include government policies in the form of tariff and non-tariff barriers to trade, as well as interventions in direct investment itself. For Canada, real or perceived changes in policy, especially with respect to foreign investment (FIRA) and energy policy, have had a significant impact. Other factors that influence firms' decisions on where to locate investments are aspects of oligopolistic competition -- market-share strategies and so on. Authors that stress market imperfections (e.g., Hymer (1976)) implicitly downplay the relative role of expected returns, at least in the narrow way that they are usually defined, on foreign direct investment. However, the factors described in this paragraph are difficult to quantify and have not been rigorously tested.

As regards portfolio investment in equities, the flows are not easily related to a few explanatory variables. An equation in the RDX2 model (Helliwell et al. (1971)) had a small but significant coefficient on a rate of return differential. It also had numerous dummy variables to account for special events and was not robust enough to survive in the RDX series of models.

5.2.2 Rate of return differentials

Measures of rates of return on real capital are notoriously difficult to calculate on a consistent basis over time and across jurisdictions. It is impossible to control reliably for different inflation rates, taxation systems (especially the treatment of non-resident earnings), valuation and other accounting conventions, and so on. Calculated returns are very sensitive to different methods of valuing capital, and theory provides no

guide as to which methods should be used (Hill (1979)). For this reason, authors such as Feldstein (in work discussed below) eschew cross-country comparisons of rates of return data.

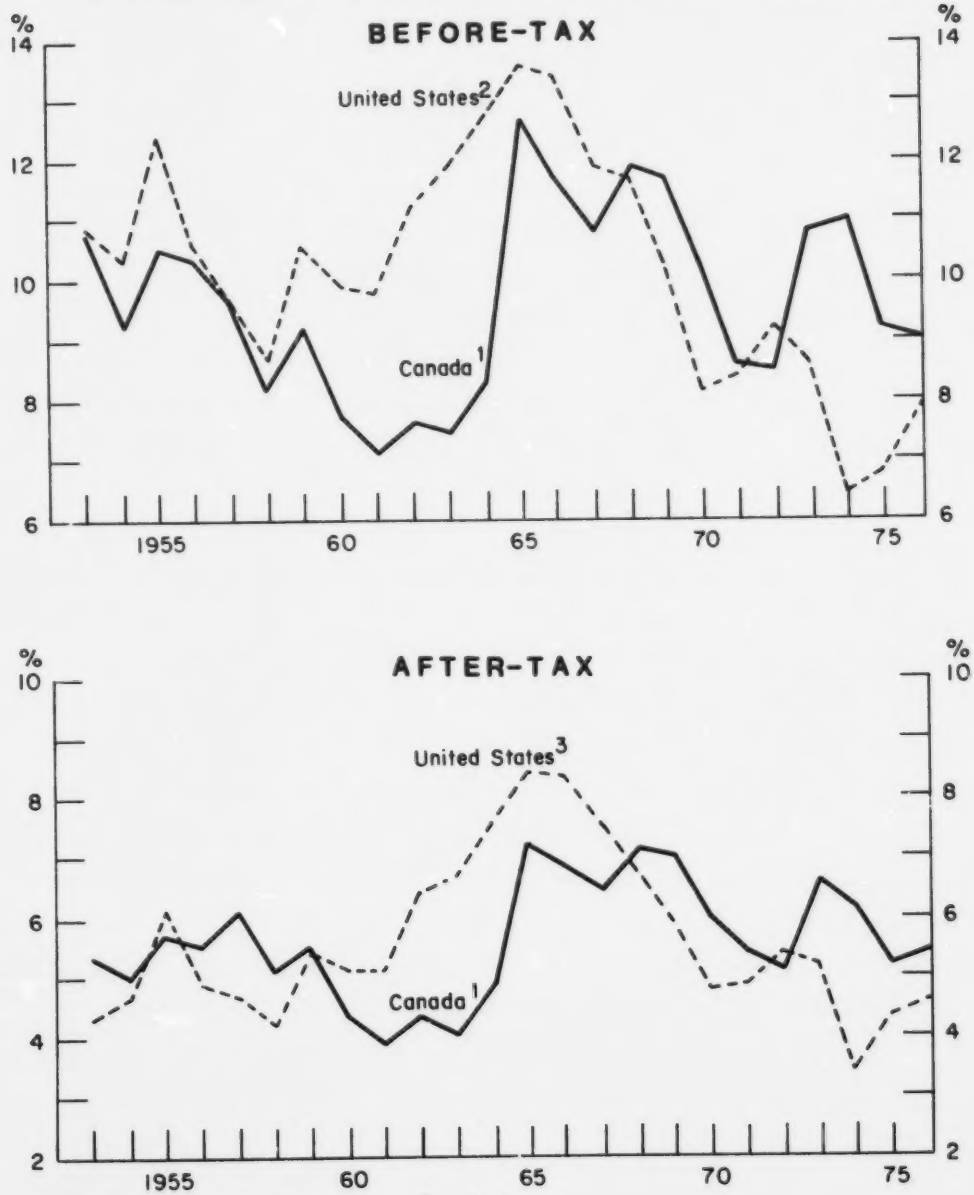
For what they are worth, the measures that exist show a wide divergence of returns between countries, as in Harberger (1978) for the 1969-71 period. Curiously enough, Harberger argued that his data were consistent with infinitely elastic capital flows. He reasoned, assuming production technologies to be similar, that rates of return were not inversely correlated with capital/labour ratios as they would be if capital were immobile. However, the differences in returns across countries, which spanned a range of 5 to 15 per cent if the data are to be believed, are simply inconsistent with the usual notion of perfect capital mobility. In a later article, Harberger (1980) backed away somewhat from the hypothesis, and conjectured that his data were consistent merely with long-run equalization of returns to capital.

Canada and the United States had much closer rates of return than other country pairs in Harberger's estimates. On a pre-tax basis, the estimated marginal net productivity of capital was almost the same for Canada and the United States, while on a net-of-tax basis the Canadian rate was just over one per cent higher. As far as one can judge, these results are robust. Consider for example the alternative series of estimates, plotted in Figure 5.1 for both the U.S. and Canadian non-farm, non-financial sectors. Although different authors are responsible for each country's data,[1] the returns are calculated on roughly the same basis. On average over this period there is no significant difference in either pre- or post-tax returns as measured, but the correlation of the annual movements is quite low (the correlation coefficient is approximately 0.3 for both pairs of returns). Canadian and U.S. profit rates peaked in the mid-1960s, but Canadian rates held up much better than U.S. rates through to the mid-1970s. The resource boom caused a strong resurgence in the profit rates of Canadian industry from 1972 to 1974

1. That is, Tarasofsky et al. (1981) (conventional) estimates for Canada, and Feldstein and Summers (1977) and Kopcke (1978) for the United States, pre- and post-tax estimates, respectively.

Figure 5.1

REAL RATES OF RETURN ON CAPITAL
IN THE NON-FARM, NON-FINANCIAL SECTOR



1. From Tarasofsky et al.'conventional' method.
2. From Feldstein and Summers.
3. From Kopcke.

while U.S. profit rates were declining. Also, the measures of corporate returns in Canada relative to the United States in this period may be swollen by the higher rate of inflation in Canada. For example, Gilson (1984) calculates an inflation-adjusted rate of return for Canada that is substantially lower than the unadjusted rate. In short, given the conceptual problems and the margin for data error, the divergences in measured rates of return are not large enough to rule out a high degree of substitutability of non-farm, non-financial capital between Canada and the United States. The divergent movements sometimes observed from year to year can in large part be attributed to the differential impact of the business cycle and to the greater concentration of resource-based industries in Canada.

If equity investment is regarded as a claim on real capital, then an alternative test of the hypothesis that the marginal product of capital is equalized across countries would be to look for a tendency towards equality of returns in different stock markets. In principle, the conceptual problems of deriving ex post returns for equity are less than for real capital itself, at least over a given holding period. However, measured returns on stock market investments in all countries are very volatile. Average differentials ex post in different markets depend very much on the time periods chosen, and the correlations of annual returns over time are so low as to give potentially large gains to international diversification of stock portfolios (Ibbotson et al. (1982)). From the point of view of mean-variance analysis, a risk-return-efficient portfolio for a well-funded, risk-averse investor would normally contain both Canadian and foreign stocks. This would imply that equity shares are less than perfect substitutes; investors would not plunge from one to another in response to a change in expected yields in one stock, but merely adjust the mix of stocks held in the portfolio. Such behaviour would ensure that a change in the expected equity yield abroad would result in a change in the same direction of the equilibrium equity yield in Canada. In fact, over long time spans, returns on stocks in the United States and in Canada do not show very large differences.

5.3 Savings, Investment, Current Account Studies

The current account balance is by definition equal to total domestic savings (including the government budget surplus) minus domestic investment. This identity is a useful starting point for analysis of the behaviour of the current account as long as the assumption of full employment holds. Hence, it is a less useful approach in the short-to-medium run than in the long run (Cuddington (1982)).

Artus (1979) argued that if capital flows among countries are highly mobile, current account imbalances need not cause significant adjustment difficulties. An excess of investment over savings, for example, would be matched by an offsetting inflow of foreign savings without a large change in interest rates and/or exchange rates. From an examination of the experience of the United States, Germany and Japan in the 1970s, Artus observed that private capital flows covered little of the existing current account imbalances. In consequence, pressures on exchange markets were substantial, and in large part central banks financed the imbalances through official exchange market intervention.

Artus noted that there are various impediments, including official restrictions and institutional rigidities in Germany and Japan, that prevent smooth transfers of funds among countries. By contrast, Canada has comparatively open capital markets and has been able to maintain substantial inflows of savings over the years without a chronic adjustment problem and without much higher interest rates than in the United States. Even so, private long-term capital flows have not financed the current account deficit smoothly from year to year. For example, over the years 1960 to 1982 there was a positive correlation between the two variables. The variance of the basic balance (the sum of the current and long-term capital account balances) was in consequence substantially greater than that of the current account. This forced a great amount of adjustment onto short-term capital flows and at times caused sharp exchange rate pressures. This would seem to be indicative of less than perfect capital mobility despite the relatively close integration of the Canadian and U.S. financial markets.

In international markets as a whole, the existence of huge volumes of gross capital flows need not imply that net transfers of savings are highly responsive to rates of return on real capital.

The real transfer of savings from abroad is given by the current account deficit. With perfect mobility, an exogenous increase in domestic savings would cause no change in the domestic rate of return and hence no change in domestic investment. Instead, the current account balance would increase one for one with the increase in savings. On the other hand, with perfect immobility, domestic investment would increase one for one.

Feldstein and Horioka (1980) and Feldstein (1983) regressed the ratio of investment to GNP on the ratio of savings to GNP for a cross section of OECD countries. They found a high correlation with a regression coefficient not significantly different from unity. They interpreted this to mean that savings are bottled up by market imperfections.

There are some technical problems with this attractively simple test of the perfect mobility hypothesis. First, cross-section data do not reveal what would happen in any given country if it were to take measures to change its savings rate. If countries have adjusted their savings quite closely to investment opportunities, the extra savings might go abroad through a current account surplus (Tobin (1983)). One reason this supposition has some credibility is that the countries concerned have often adopted policies designed to reduce current account imbalances (Westphal (1983)). Second, use of the savings ratio as the exogenous variable to 'explain' investment, begs questions because of the identity that ties them to the current account. Third, Harberger (1980) argued that the results may apply only to the larger economies; some of the smaller industrialized economies have sizeable divergences between savings and investment rates. Fourth, accounting definitions will bias the estimates if savings and investment both include capital depreciation, and if residential construction is included both in investment and in household earnings. However, Feldstein shows that his results are unchanged when investment is defined on a net basis and is exclusive of residential construction. Finally, investment and savings respond to some

extent to common third factors. Von Furstenberg (1980) found that the underlying determinants of investment and savings in the United States contributed to a downward trend in both. This would give rise to a time-series analogue of the correlation found by Feldstein without any implication that real capital is immobile.

Sachs (1981, 1983) came to conclusions that were at variance with Feldstein's on the basis of regressions of the change in the current account/GNP ratio between the 1960s and the 1970s on that of the investment/GNP ratio. Regressions with levels, instead of changes, in these variables produced similar results. Again, a cross section of OECD countries was involved. Sachs justified his choice of equation on the empirical judgement that variance in the investment ratio has been the more significant proximate cause of variance in the current account: he found shifts in national savings ratios to be virtually uncorrelated with the shifts in current accounts that occurred between the 1960s and the 1970s. By implication, Sachs argues that countries with high investment opportunities have been able to draw on highly mobile savings in the rest of the world; he cites in particular the flow from the OPEC countries to the rapidly industrializing countries in the mid-1970s.

Sachs does not argue that government deficits can be easily financed by foreign borrowing, since these are defined as reductions in national savings. In this respect, we have an agreement between Sachs and Feldstein that is central to the discussion of policy in Section 5.4.

However, there are inconsistencies between the findings of the two authors that are as yet unresolved. Neither author's interpretation of the data has a firm statistical foundation since the correlation between components of a definition is not a valid indicator of causality. Empirically, it would appear that Sachs' conclusions are the less reliable: the coefficients in his regression equations are unstable over time and the conclusions can be completely upset by minor changes in country coverage (Wyplosz (1983)). Further, from the theoretical viewpoint, the regressions in time-difference form are particularly suspect. Given the full-employment orientation of the savings/investment approach,

Feldstein's explicit focus on long-run differences between countries seems more appropriate (Fischer (1981)).

These regression equations are not structural relations but, at best, are reduced forms in which the coefficients are non-linear functions of the elasticity of domestic savings and investment schedules and other parameters as well as the elasticity of capital flows. As long as the capital flow is not infinitely elastic, the elasticity of the IS schedule relative to the elasticity of the foreign balance schedule determines the proportion of investment at the margin that is financed at home. If it is true that domestic spending is less interest-elastic than the capital flow,[2] then the propensity to import savings to finance investment is increasing at the margin.

A further limitation of these studies is that they ignore the intertemporal aspects of capital accumulation and foreign investment.

In view of the questionable validity of the statistical tests as well as the conflicting findings, these investment/savings/current account studies in the end shed only a little light on the elasticity of real capital flows. If anything can be concluded it is that there is a substantial degree of immobility in the world market as a whole. But casual observation of economic history and of the economic links between Canada and the United States suggests that this conclusion is less applicable to Canada than to other large industrial countries. Foreign ownership, for example, accounts for a much higher proportion of the business capital stock in Canada than elsewhere, and official policies towards capital movements have, outside of wartime and post-war reconstruction, been very liberal compared with other countries. As well, the relatively close estimates for rates of return on capital confirm that real capital is much more mobile between Canada and the United States than among the other countries included in the cross-section studies.

The stylized facts about Canada demonstrate why it is difficult to draw conclusions from savings/investment data. Over the decades, Canada

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2. This assumption may well be correct, but it is outside the scope of this study to provide evidence on the elasticity of domestic spending.

has had a high investment ratio and a high savings ratio relative to the United States. It has also had a current account deficit that has typically provided 10 to 20 per cent of the financing of domestic investment if retained earnings of foreign-owned firms are included. One might look at the current account deficit and conclude that, since ex post rates of return in Canada have not been demonstrably much higher than those in the United States, capital must have been highly mobile. In contrast, one might look at the savings ratios and conclude that quantitatively, domestic saving has been the basic source of the higher investment ratio in Canada, with imported savings a smaller component than would be expected with perfect mobility.

5.4 Fiscal Policy in the Long Run

In this section a classical approach is used to examine the influence of international asset substitutability on the long-run effects of fiscal policy. If there is a vertical supply curve, crowding out is complete in that fiscal policy cannot change output in the long run. The degree of capital substitutability remains an important determinant of the types of activities that are crowded out, but not of the total change in output. Therefore, we are basically concerned here with allocative questions.

Of course, a great many parameters besides the elasticity of capital substitution are relevant to these questions -- for instance, the interest rate elasticities of domestic investment and savings functions. But these require a complete macroeconomic model of the economy for their elucidation and are beyond the scope of the present study. The broad issues with which we are concerned here can be handled satisfactorily by the simple version of the classical model provided by L.A. Metzler (1960).[3]

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3. We are aware that this model ignores certain features emphasized in the new-classical macroeconomics, viz., intertemporal utility maximization and the notion that government debt service payments are fully discounted as future tax liabilities by the private sector. Incorporation of these features would complicate the analysis without necessarily affecting the substance of the results.

We abstract from the possibility that bond-financed budget deficits may in the long run lead to dynamic instability.[4] The elasticity of capital substitution does not appear to be a critical parameter in this regard: instability results essentially from the compounding of interest payments. Thus, it must not be inferred that perfect capital mobility rules out instability merely because the interest rate is fixed at the level prevailing in the rest of the world. With high capital mobility, instability would be manifested by an explosion in interest payments to foreigners not, as in the low mobility case, by an explosion in the domestic interest rate. In other words, GNP (which is defined as GDP minus net investment income payments to non-residents) would show qualitatively the same behaviour over differing values of capital substitutability.

The discussion below is organized as follows. Section 5.4.1 outlines a mechanism by which fiscal policy might affect the full-employment level of output in an open economy. Section 5.4.2 describes the relevant properties of Metzler's model. Implications of international capital substitutability for the effect of fiscal policy on capital accumulation and economic growth are discussed in Section 5.4.3, and for the social rate of discount, in Section 5.4.4.

5.4.1 Terms-of-trade effect on output[5]

An increase in government spending usually represents an increased demand for domestic output, raising the price of domestic output relative to the price of foreign output. This improvement in the terms of trade creates an incentive to increased labour supply and output. The degree of capital substitutability has no direct bearing on this effect, which comes about because goods produced by different countries are less than perfect substitutes. In what follows we therefore neglect this effect.

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4. There is now an extensive literature on this topic. Two examples are Masson (1983) and Scarth (1984).

5. Not to be confused with the Laursen-Metzler effect on spending.

5.4.2 The Metzler model

At full employment, the current account balance is determined by the interaction of the domestic savings and investment functions and the supply function of savings from the rest of the world.

In Figure 5.2, r_1 would be the equilibrium, or natural, rate of interest in a closed economy. However, in an open economy there is the opportunity to import or export savings, so the gap between SS and II is the current account balance. The rate of interest in the rest of the world, which is exogenous for a small country, is r_u. The domestic interest rate has to be greater than r_u to attract imports of savings from the rest of the world; there would normally be a rising supply price as illustrated by the supply function KK in the second part of Figure 5.2. With perfectly elastic capital flows the domestic interest rate would be reduced[6] to r_u and the equilibrium trade deficit would be ab. With less than perfect elasticity, equilibrium occurs where the current account deficit is equal to the supply of savings from the rest of the world, which occurs at interest rate r_2 and current account deficit (capital inflow) cd. The equilibrium interest differential is $r_2 - r_u$.

A switch in demand between domestic goods and foreign goods cannot cause the current account to change. 'Trade' shocks affect the real exchange rate, not the trade balance, which in full employment equilibrium positions is determined completely by savings and investment choices, including portfolio-balance choices.[7]

An expansionary fiscal policy can be regarded as an increased government deficit. In Figure 5.3 this is represented by a leftward shift in the SS schedule by the amount of the increase in the deficit to S'S'.

With perfect capital mobility, the current account deficit is increased from ab to eb i.e., by the full amount of the increased

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6. It is assumed that expectations are unbiased in the long run and that all prices are fully flexible.

7. The KK schedule is dependent on asset preferences of foreign residents as well as on their savings and investment decisions.

THE METZLER MODEL

Figure 5.2

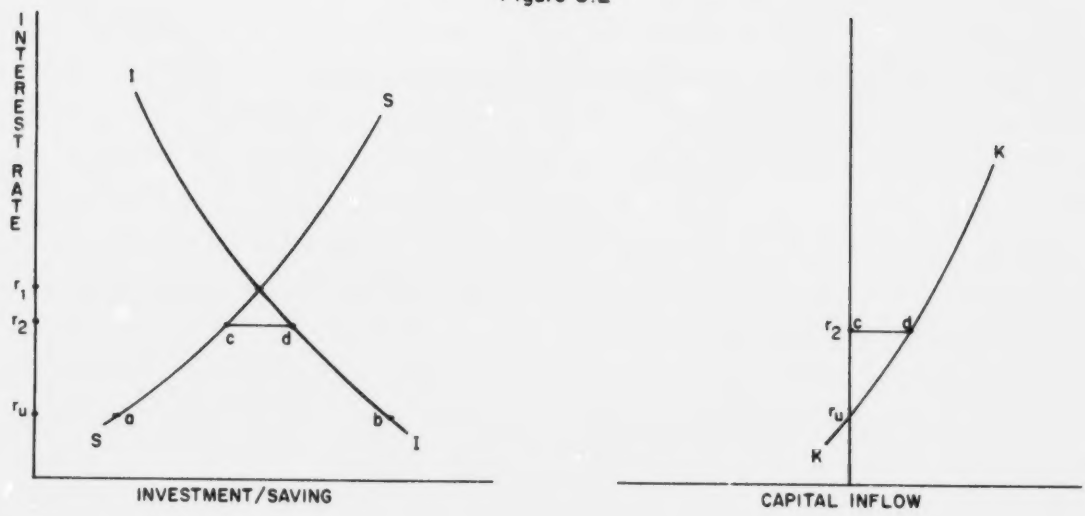
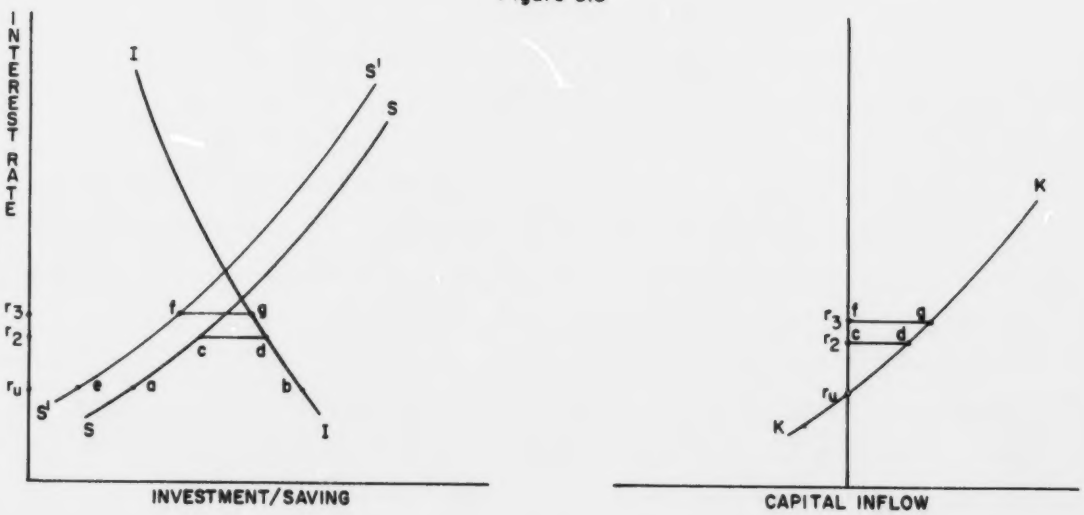


Figure 5.3



government deficit. Since the real exchange rate has to adapt to be consistent with the increased trade deficit there is real appreciation of the currency, which reduces demand for net exports. The rate of interest is unchanged and there is no crowding out of private domestic investment and consumption.

In the case of imperfect capital mobility, the equilibrium current account deficit increases from cd to fg and the domestic interest rate increases from r_2 to r_3. Here, the increased government consumption is partly accommodated by a decrease in domestic investment.

Emphasis on the imperfect mobility case is warranted because an increase in government spending cannot plausibly be assumed to extract an indefinitely prolonged transfer of savings from the rest of the world without an eventual increase in the returns paid to foreigners. As emphasized above, the empirical findings of Feldstein and Sachs are consistent on this point. Sachs' results would indicate that Canada's past current account deficits have been relatively easily financed only because they corresponded to high levels of investment.[8]

5.4.3 Capital accumulation

In the long run, the relevant issue is not whether crowding out will occur, but what form it will take. Increased government budget deficits at full employment imply reduced private capital formation somewhere in the world.

The degree of capital mobility affects the extent to which crowding out occurs through the balance of trade and through domestic investment. As argued above there is no evidence that the elasticity of the international allocation of real capital is high enough to prevent some crowding out of domestic investment in the long run. Unless the increased government spending is on investment projects with a social rate of return no less than that in the private sector, this in turn would imply lower long-run economic growth. It does not immediately follow that an

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8. Clinton and Longworth (1982) discuss the Canadian example in more depth.

effective method to encourage capital formation would be to cut the government deficit and to increase incentives to private saving. Quite aside from the fact that some of the increased savings would leak abroad in the form of an increased capital outflow, the short-run deflationary impact would cut investment, and hence have a long-run effect on output if the capital stock is thereby lowered permanently (Tobin (1983)). A more reliable way to encourage growth would be a combination of reduced government spending and increased incentives to private saving along with incentives to business investment, as advocated by Feldstein et al. (1983) for the United States. For Canada it is less clear that increased incentives to private savings are necessary, one reason being that the greater openness of our capital market would cause a greater leakage of savings abroad.[9]

Capital mobility allows fiscal policy in the rest of the world to affect investment in Canada. Thus, increased budget deficits abroad reduce the supply of savings available to be invested in Canada. The degree of capital mobility between Canada and the United States is high enough that an increase in the real interest rate in the United States caused by increased U.S. government borrowing will cause a roughly equal increase in real rates in Canada in the long run. This suggests that increased budget deficits in the United States will have effects on capital formation in Canada in the longer run.

5.4.4 The social rate of discount

Different assumptions about the elasticity of the capital inflow make a significant difference to the appropriate rate of discount to use in cost-benefit analysis (Burgess (1981) and Jenkins (1981)). Given a lower rate of return abroad than at home, the higher the proportion of investment financed at the margin by foreign savings the lower is the social rate of discount.

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9. Also, in Canada the tax and regulatory distortions that Feldstein et al. want to correct are less apparent (Clinton and Longworth (1982)).

Two comments might be made on this topic. First, the appropriate definition of the capital flow for this purpose is probably the current account deficit plus retained earnings of foreign subsidiaries since we are concerned with the allocation of real resources and hence with real capital transfers rather than financial flows per se. Cost-benefit specialists point out there can be a considerable difference between the marginal social product of real capital and the rate of interest on financial assets. The proportion of gross domestic investment financed from abroad under the above definition of the capital inflow averaged about 14 per cent[10] over the 1955-78 period. This is lower than the 20 per cent figure used by Burgess and Jenkins, which is based on a conceptually awkward definition of gross foreign savings.[11]

Second, the derivative of the savings inflow with respect to rates of return rather than the elasticity is the operative parameter. Elasticities lose meaning when the dependent variable takes negative values, as does the net inflow of savings. It is not clear that an adequate approximation to the proportion of investment financed at the margin by a capital inflow can be derived from the product of the average proportion times some elasticity estimate, which is the procedure that has been used. In any event, it is necessary that the definition of the capital inflow used to estimate the elasticity is the same definition used to measure the average. In particular, it is hazardous to use an elasticity estimate derived from a study of a particular component of the capital account of the balance of payments as if it applies to the overall net flow.

This is an area greatly in need of further research. For the present we can only recommend that in calculating the social rate of discount, a wide range of assumptions for the derivative of the capital flow with respect to the cost-of-capital differential be examined. Since the

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10. The ratio is quite volatile from year to year, ranging from minus 2 per cent in 1970 to 25 per cent in 1975.

11. For example, the published gross inflow through the banking system is the sum of net flows across arbitrarily defined geographical jurisdictions. More fundamentally, use of the gross inflow seems to ignore the fact that investment can also be financed from reduced purchases of assets abroad by Canadian residents.

implicit time horizon is the longer run, the extreme case of perfect capital mobility is not to be rejected out of hand.

5.5 Conclusions

Empirical equations for direct investment and equity investment flows have not been a great success. They tend not to be robust over time and over differences in definitions for the variables employed. Often the coefficients on rates of return variables, when these are explicitly included, have large standard errors. Part of the problem is that in Canada's balance of payments, direct investment measures foreign financing of acquisitions of capital assets as opposed to foreign purchases of new capital goods.

Studies that include retained earnings in the direct investment flow are more apt to find significant rate of return effects. Moreover, in the long run, roughly comparable measures of rates of return in Canada and in the United States tend not to show significant differences. This holds for estimated rates of return on real capital as well as on equity. A tenable conclusion is that there is a fairly low degree of substitutability of claims to real capital between Canada and the United States in the short run, and a much higher degree in the long run. Unlike the conclusion for interest-bearing assets though, we cannot be sure that perfect substitutability is a reasonable assumption in the long run.

Studies using multi-country cross-section data on investment, savings, and the current account have not been favourable to the perfect mobility hypothesis. However, there are serious technical problems with the tests used in these studies. Moreover, in view of the close economic integration of Canada and the United States and relatively liberal policies towards capital movements, the degree of mobility is probably much higher for Canada than for other large industrial economies. Thus the cross-section results are not inconsistent with a very high elasticity of the supply of foreign savings to Canada in the long run.

This does not mean that government consumption expenditures or transfer payments could be financed in foreign markets for long without

running into increased costs of borrowing. Although, historically, Canada has used foreign savings to sustain a high level of investment, it would not be possible to borrow on such favourable terms indefinitely to finance a high level of consumption.

In the long run, fiscal policy has an important effect on the allocation of resources. If we assume full employment, an increase in government spending financed by selling bonds causes the balance of payments on current account to decrease and/or domestic spending to decrease. In the case of an increase in government investment spending it is possible that the outcome will be an almost one-for-one increase in capital inflows with no crowding out of domestic investment. In the case of an increase in government consumption spending it is less likely that foreigners would provide a large proportion of the required savings. Therefore one would expect some crowding out of domestic investment as well as a decline in the current account balance.

APPENDIXES A - D

APPENDIX A

COVERED INTEREST ARBITRAGE AND TRANSACTIONS COSTS

This Appendix considers two points: how well the covered interest arbitrage condition $(1+i)=(1+i^*)F/S$ approximates reality and how large are transactions costs for the Canadian dollar in the foreign exchange market. Quantitative evidence on these topics, together with interest rate differentials between Canadian dollar financial instruments in the domestic and Euromarkets, is used to argue that political risk is unimportant for short-term capital flows between Canada and the United States.

Frenkel and Levich (1981) calculated the absolute values of deviations from covered interest rate parity with weekly data for the period from June 1973 to December 1979. Their results are summarized in Table A-1. It can be seen in the table that 99 per cent of the deviations from interest parity lie within the 0.75 per cent range. Moreover, both the mean deviations and the mean absolute deviations are less than 1/4 of a percentage point.[1] The mean absolute deviations for Canada are less than for all corresponding instruments for the other countries (vis-à-vis the United States) considered by Frenkel and Levich (the United Kingdom, Germany, Italy and Japan) except for the 3-month Euro rate for Germany.

It is worth noting that deviations from covered interest arbitrage in the Euromarket are smaller than corresponding deviations among treasury bills. This is to be expected since the same banks provide deposits in both currencies and therefore are naturally unwilling to provide free profits from arbitrage opportunities to customers at their own expense.

The calculations in Table A-1 do not take into account transactions costs. When Frenkel and Levich do take estimated transactions costs into account, 99.7 per cent of the 3-month treasury bill deviations and 100 per cent of the 3-month Euro-rate deviations are found to lie within a neutral band bounded by those costs.

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1. In a comparison between U.S. Eurodollar rates and Canadian chartered bank deposit rates, Longworth (1983) used a regression approach to show that in 1979 mean deviations from covered interest parity were about 0.24 per cent at annual rates.

Table A-1

ABSOLUTE VALUES OF DEVIATIONS FROM COVERED INTEREST PARITY
Weekly data, June 1973 to December 1979

Instrument comparison (U.S. and Canada)	Percentage of absolute values within: 0.3%	0.5%	0.75%	1.0%	Mean deviation	Mean absolute deviation
Treasury bills (3 mos.)	76.7	92.7	99.1	100.0	0.11%	0.21%
Euro rates (3 mos.)	99.4	100.0	100.0	100.0	-0.06%	0.07%
Euro rates (12 mos.)	71.8	95.1	99.1	100.0	-0.19%	0.23%

Source: Frenkel and Levich (1981, p. 268)

Furthermore, transactions costs in financial markets are likely to be small. For example, transactions costs for spot (Table A-2) or forward foreign exchange in the foreign exchange market, as indicated by the bid-offer spread, are generally smaller for the Canadian dollar than for other major currencies in transactions vis-à-vis the U.S. dollar.[2] These low transactions costs are therefore one of the causes of the slight deviations from covered interest parity.

Table A-2

BID-OFFER SPREADS AS PERCENTAGE OF RATE: 1980-81

Currency	Percentage spread
Canadian dollar	0.030
U.K. pound	0.062
German mark	0.053
Japanese yen	0.075
French franc	0.073
Italian lira	0.094

Source: Average of daily data for 1980-81 from the Bank of Canada

The small deviations also indicate that political risk, if it exists, is not important quantitatively for short-term assets. Moreover, if political risk were the only factor explaining differences between domestic and Euro rates in the same currency one would expect that domestic rates would be above the Euro rates quoted in a banking centre, like London, where there is little perceived risk of interference with non-resident transactions.[3] Indeed, Dooley and Isard (1980) have shown

2. The percentage bid-offer spreads for forward exchange for the Canadian dollar in the period from June to October 1983, were on average smaller than comparable percentage spreads for other currencies in the 1973-81 period reported in Appendix B of Longworth et al. (1983).

3. This analysis proceeds entirely from investors' demand for financial instruments. From the point of view of suppliers of financial instruments, in particular the banks, the presence of reserve requirements, deposit insurance and regulatory requirements may cause them to offer lower interest rates domestically than in Euromarkets. See Bank of England (1979) and Logue and Senbet (1983). The subsequent analysis here assumes that if political risk is important it will have to outweigh these supply factors.

that existing and future capital controls in Germany caused domestic German rates to exceed Euro-mark rates. The evidence for Canada, however, as reported in Table A-3, indicates that this type of political risk is not important, since domestic interest rates are more often than not below, rather than above, Euro rates.

Table A-3

AVERAGE DIFFERENCES BETWEEN 90-DAY DOMESTIC AND EURO-CANADIAN INTEREST RATES

Year	Domestic rate		Chartered bank deposit receipts
	Treasury bills	Finance paper	
1975	-0.58	-0.05	-0.20
1976	-0.39	-0.09	0.05
1977	-0.05	0.09	0.14
1978	-0.06	0.10	0.10
1979	-0.13	0.26	0.23
1980	-0.27	0.09	-0.19
1981	-0.57	0.04	-0.14
1982	-0.73	-0.22	-0.63
Overall average	-0.35	+0.03	-0.08

Source: Cansim series B14007, B14017, B14043 and U.K. Financial Times (for mid-market Euro-Canadian rate). Data are for the last Wednesday of the month for finance paper and chartered bank deposit receipts, for the Thursday tender following the last Wednesday of the month for the treasury bill rate, and for the last Tuesday of the month for the Euro-Canadian rate (except where missing data necessitated the use of the next-to-last Tuesday).

APPENDIX B

ECONOMETRIC RESULTS WHEN ELASTICITIES ARE (NEARLY) INFINITE

In this Appendix we show that when domestic and foreign assets are almost perfect substitutes (that is, when capital flows are nearly infinitely elastic) one cannot trust the empirical evidence from equations estimated with the relative asset stock variable as the dependent variable.[1] Let the demand equation be specified as:

$$A = a + b\,(i - i^* - \Delta s^e) + u$$
$$= a + b\,r + u \qquad (1)$$

where $r = i - i^* - \Delta s^e$,
A = the relative asset stock variable,
i and i^* = the domestic and foreign interest rates, and
Δs^e = the expected change in the exchange rate.

Now, if demand were perfectly elastic and there were no transactions costs and measurement errors, r would always be zero and it would be impossible to estimate equation (1). However, both transactions costs and measurement errors (however minor) are usually present. In this case, r might be approximated by a random error, say v. Then estimating equation (1) by ordinary least squares would lead to an estimate of b that was not significantly different from zero.[2] It is also possible that, if

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1. Here, 'relative asset stock variable' is shorthand for the stock, flow, relative stock, or stock-to-wealth variable that is the dependent variable in a properly specified demand equation.

2. $$\hat{b}_{ols} = \left[\frac{\frac{r'A}{n} - \bar{r}\,\bar{A}}{\frac{r'r}{n} - \bar{r}^2} \right]$$

where $\bar{}$ denotes mean and n is the number of observations. In the probability limit, $\text{plim}\,(\hat{b}_{ols}) = \frac{\sigma_{uv}}{\sigma_{v}^2} = 0$ if u and v are uncorrelated.

measurements of expectations are rather noisy so that the variance of the error term v is large, the estimate of b could be small even if there were a small degree of imperfect substitutability and thus a measurable degree of correlation between A and r.

APPENDIX C

A BRIEF SURVEY OF THE ELASTICITIES OF CANADIAN TRADE VOLUMES WITH RESPECT TO RELATIVE PRICES

When international capital substitutability is not perfect, the size and dynamics of exchange rate changes will depend, among other factors, on the effect of exchange rate changes on the current account. This, in turn, will depend on the response of trade volumes and prices to the exchange rate changes.

It is generally agreed that Canada is a price-taker for its imports, so exchange rate changes will be reflected one for one in import prices. With respect to exports, Canada is likely a price-taker for some of its raw materials exports and a price-setter, at least to some degree, for some of its more highly manufactured exports. Therefore, export prices will respond less than one for one to exchange rate changes.

The response of trade volumes to changes in relative prices induced by exchange rate changes has been the subject of a large number of empirical studies. Early studies were surveyed by Stern, Francis and Schumacher (1976). Goldstein and Khan (1984) have surveyed more recent studies. Those studies, plus work by Yadav (1977) and in the Bank of Canada RDXF model (as of 1983) are summarized in Table C-1. It can be seen in the table that there is a wide range of estimates for the price elasticity of demand for exports (ranging from -0.23 to -1.10) and the price elasticity of demand for imports (ranging from -0.20 to -2.50) with the results depending on the sample period, the frequency of the data, and the specification of the model.

Table C-1

ESTIMATED LONG-RUN ELASTICITIES OF THE DEMANDS FOR CANADIAN EXPORTS AND IMPORTS WITH RESPECT TO RELATIVE PRICES

Study	Export elasticity	Import elasticity	Estimation period	Comments
Houthakker-Magee (1969)	-0.59	-1.46	Annual 1951-66	
Adams et al. (1969)	-0.23	-0.62	Quarterly 1955Q4-1965Q4	
Hickman-Lau (1973)	-0.84	N/A	Quarterly 1961-69	-0.59 in short run
Basevi (1973)	-0.59	N/A	Annual 1953-late 1960s	Disaggregated Source: TRACE model as of Sept. 1971 as used in Project LINK
Samuelson (1973)	-1.10	-1.29	Semi-Annual 1960-72	Almon variables used
Taplin (1973)	N/A	-1.59	Annual 1953-70	
Beenstock-Minford (1976)	-1.00	-2.50	Quarterly 1955Q1-1971Q4	
Stern et al. (1976)	-0.79	-1.30	N/A	Median of range of estimates by various authors
Yadav (1977)	N/A	-1.37	Quarterly 1956-73	-0.60 in short run
Goldstein-Khan-Officer (1980)	N/A	-0.78	Annual 1951-73	Constrained equation reported in Table 5
Amano et al. (1980)	-0.33	N/A	Quarterly 1970-77	Average of estimates
RDXF (1983)	-0.58	-0.63	Quarterly c.1968-81	Summary of results from disaggregated RDXF equations as of March 1983

APPENDIX D
DATA SOURCES AND CONSTRUCTION

In this Appendix we describe the data used to estimate the equations in Chapters 2 and 4. The data can be divided into two main groups: interest and exchange rates, and bond and wealth stocks. We begin by describing the rates data.

The 1- , 2- , 3- , 5- , 10- and 20-year bond yields were taken from hypothetical yield curves constructed for government bonds. The U.S. bond yield data are monthly averages of daily series constructed by the U.S. Treasury and reported in the Treasury Bulletin. Canadian yields are monthly averages of unpublished weekly series constructed by the Securities Department of the Bank of Canada. Treasury bill yields for both countries are monthly averages of daily 90-day closing yields again supplied by the Securities Department of the Bank of Canada. The spot exchange rate series is the monthly average of daily noon exchange rates and the monthly PPP variable is the ratio of most recently announced GNE deflators for both countries.

Bond stock data (a summary description is included in Table 2 of Chapter 2) for Canada are constructed as follows:

$$B = BPM + BCSB + MB + BTB + BGD - GACC - BBOC$$

where

B = total Canadian outside bond stock,
BPM = outstanding provincial and municipal bonds,
BCSB = outstanding Canada Saving Bonds,
MB = monetary base,
BTB = outstanding treasury bills,
BGD = outstanding debt guaranteed by the federal Government,
GACC = federal Government bank balances, and
BBOC = treasury bills and federal Government bonds held by the Bank of Canada.

The wealth measure for Canada is simply B plus the cumulated bilateral current account balance (cumulated from 1926 onward). Monthly data are

used whenever possible, otherwise we interpolate quarterly data to obtain monthly observations.

The U.S. bond stock and wealth series are constructed following the methodology of Frankel (1982a). The U.S. wealth series is constructed with the U.S. bond stock series and the cumulated bilateral current account balance as above. World wealth, when used, is simply the sum of the two countries' bond stock series.

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